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ARMS CONTROL RESEARCH

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An Annotated Bibliography

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Yucca Mountain Project Bibliography, 1977–1985 (Formerly *Nevada Nuclear Waste Storage Investigations, 1977–1985: A Bibliography*). June 1987. 759 refs. DOE/TIC-3406 (DE86013045).

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Waste Isolation. February 1985. 590 refs. DOE/TIC-3388 (Suppl.1) (DE85003092).

This publication is available from OSTI as TI95021202

Arms Control Research

35 ARMS CONTROL

1 **We all lost the Cold War.** Lebow, R.N.; Stein, J.G. 542p. Princeton Univ., Princeton, NJ (United States) (1994).

From review by Allan S. Krass, Hampshire College, in Bulletin of the Atomic Scientists, Vol. 50, No. 5 (Sep-Oct 1994).

The purpose of the book is to use the experience of two actual Cold War crises to test the hypothesis that it was the U.S. strategy of deterrence that was primarily responsible for preventing war with the Soviet Union and teaching them that aggression would not pay. The two crises; the Cuban missile crisis of 1962 and the Middle East crisis of 1973 have been widely interpreted as victories for U.S. deterence strategy. The authors draw on sources that were previously unavailable, both documents and interviews. The authors show that it was the fear of any nuclear use, not quantitative assessments of the nuclear balance, that deterred both Soviet and American leaders in the two crises examined. Each side believed that the loss of even a single city was unacceptable. This implies that the benefits of nuclear weapons derive from their ability to annihilate cities. A policy of finite deterence would rely almost exclusively on this threat to civilians, raising further moral questions.

2 **Nuclear arms reduction and Russian laboratory conversion through joint US/RF cooperation.** DeVolpi, A. (Argonne National Lab., IL (United States)); Minkov, V. pp. 63 of The 160th national meeting of the American Association for the Advancement of Science: Science and a changing world. American Association for the Advancement of Science, Washington, DC (United States) (1994). pp. 240 (CONF-940257–: 160. national meeting of the American Association for the Advancement of Science (AAAS): science and a changing world, San Francisco, CA (United States), 18-23 Feb 1994).

Russian nuclear-weapons laboratories (particularly Arzamas-16 and Chelyabinsk-70) are central factors in arms reductions and conversion to nonmilitary activities. The technical leadership, staff, and support structure of the laboratories have experience, competence, and motivation to increase the pace and fulfillment of arms reductions-development staff to productive nonmilitary activities is needed in order to deter the export of skills and knowledge that could aid proliferation of weapons of mass destruction. Two years after passage of Nunn-Lugar legislation and one year after the inauguration of a new presidential administration is a good time to take stock of progress and the remaining agenda for further disarmament and conversion, and look at new approaches to cooperation and support. This session will bring together key russian weapon-lab scientific leaders, MINATOM officials. International Science and Technology Center administrators, and U.S government decisionmakers in order to stimulate a public dialogue for scientists that might contribute to collaborative R&D/ industrial activities.

3 **Nuclear weapons dismantlement and its aftermath (session 1).** Johnson, P. (Office of Technology Assessment, Washington, DC (United States)); Morgan, R.P.; Potter, W. pp. 64 of The 160th national meeting of the American Association for the Advancement of Science: Science and a changing world. American Association for the Advancement of Science, Washington, DC (United States) (1994). pp. 240 (CONF-940257–: 160. national meeting of the American Association for the Advancement of Science (AAAS): science and a changing world, San Francisco, CA (United States), 18-23 Feb 1994).

This session will examine both technical and policy issues associated with the dimantlement of nuclear warheads and the management of nuclear materials from warheads in both the United States and the former Soviet Union. Speakers will evaluate these unprecedented efforts to make substantial and permanent reductions in nuclear arsenals, presenting both challenges and opportunities. Part 1 will cover current and future nuclear safety and safeguard issues during production and disposition of nuclear warhead materials in the several newly independent states that have such activities. Speakers include researchers from U.S., Russian, Ukrainian, and other institutions who have first-hand knowledge of programs underway and issues of concern. Part 2 will focus on U.S. programs and policies that affect future success of this endeavor in all nations involved. The results of two recent studies will be presented: one by the Office of Technology Assessment, the other by the Committee on arms Control and National Security of the National Academy of Sciences/National Research Council. Speakers include researchers who are active in this area, officials for the Department of Energy and State, and a representative of a local organization involved in public participation issues.

4 **Nuclear weapons dismantlement and its aftermath (session 2).** Morgan, R.P. (Washingtin Univ., St. Louis, MO (United States)); Johnson, P.; Holdren, J.P. pp. 64 of The 160th national meeting of the American Association for the Advancement of Science: Science and a changing world. American Association for the Advancement of Science, Washington, DC (United States) (1994). pp. 240 (CONF-940257–: 160. national meeting of the American Association for the Advancement of Science (AAAS): science and a changing world, San Francisco, CA (United States), 18-23 Feb 1994).

As a result of existing arms-reduction commitments, approximately 50 metric tons of weapon-grade plutonium (WPu) is expected to become surplus in the United States and a similar amount in Russia - over the next 10 years. It is crucial that this surplus WPu be managed in a way that (1) strengthens national and international institutions and incentives for control and reduction of nuclear weapons; (2) minimizes the danger that the WPu will be re-used for weapons by the initial possessor nation, another nation, or a subnational group; (3) does not lead to increased accessibility of other plutonium for weapon use; and (4) meets

reasonable standards for safety, health, environment, and cost. This talk will summarize the results of a year-long study of the options for achieving these goals conducted for the U.S government by the Committee on International Security and Arms Control of the National Academy of Sciences.

5 **NPTs limitations and the potential for future gain.** Domke, W.K. (Lawrence Livermore National Lab., CA (United States)). pp. 65 of The 160th national meeting of the American Association for the Advancement of Science: Science and a changing world. American Association for the Advancement of Science, Washington, DC (United States) (1994). pp. 240 (CONF-940257–: 160. national meeting of the American Association for the Advancement of Science (AAAS): science and a changing world, San Francisco, CA (United States), 18-23 Feb 1994).

The NPT was principally drafted by the United States and the Soviet Union to meet immediate problems in security policy. As such, its role as the cornerstone of international consensus on the role of nuclear weapons in security policy was compromised from the start. Since coming into force in 1970, the NPT has assumed a more prominent role in international nonproliferation diplomacy and agreements. However, in the absence of East-West rivalry, it may be that reliance on the NPT as a vehicle of debate and international action hinders progress on limiting the role of nuclear weapons in national and regional security policy. Various changes can be undertaken to improve the role that NPT principals can play in promoting nonproliferation and nuclear disarmament, including attachment to a universal-membership international organization and linking NPT requirements to a process of more regular review and dispute resolution.

6 **Nuclear science methods in disarmament: Chemical and nuclear weapons control.** Cole, J.D. (Idaho National Engineering Lab., Idaho Falls, ID (United States)); Drigert, M.W.; Aryaeinejad, R.; Caffrey, A.J. pp. 1050, Paper NUCL 82 of 207th ACS national meeting. American Chemical Society, Washington, DC (United States) (1994). pp. 2247 (CONF-940301–: 207. spring national meeting of the American Chemical Society (ACS), San Diego, CA (United States), 13-18 Mar 1994).

Technical support for arms control efforts, nonproliferation initiatives, and reduction in stockpiles of special nuclear material are discussed. Techniques for identification and control of chemical weapons agents and munitions are presented for use in bilateral treaty support. The techniques are based on nondestructive analysis using nuclear science methods. These are the FATS, PINS, and GNAT systems developed at the INEL. Examples of their use within treaty and non-treaty environments are presented.

7 **Sources of instability and conflict in Northeast Asia.** Pollack, J.D. (RAND Corp., Santa Monica, CA (United States)). *Arms Control Today (United States);* 24(9): 3-6 (Nov 1994).

Northeast Asia is poised on the verge of major political change and potential strategic realignment. Although among the most dynamic and economically successful of geopolitical locales, the region as a whole is suffused with interstate rivalries, incipient arms competition and potential military conflicts. To be sure, the collective interests of the major regional powers argue strongly against the outbreak of overt armed hostilities, which could severely undermine a sustained record of unrivalled economic achievement. Moreover, US forward military presence, anchored closely to major bilateral alliances with South Korea and Japan, has helped serve as the primary guarantor of peace and stability in the west Pacific for decades.

8 **China and arms control: Transition in East Asia.** Godwin, P.H.B. (National War College, Washington, DC (United States)); Schulz, J.J. *Arms Control Today (United States);* 24(9): 7-11 (Nov 1994).

With the Asian security environment in transition from the Cold War structure to whatever replaces it, prospects for arms control initiatives in the region and the attitudes and cooperative mechanisms to implement effective regimes are in a state of flux. Within Asia, Beijing's conventional and nuclear defense modernization programs, combined with its active arms export program, make China a central player in present arms control regimes and any future agreements. While the end of the Cold War and the demise of the Soviet Union meant that China lost much of its strategic significance, Beijing's growing economic and military power guarantee that it will be a major source affecting regional stability - or instability - for the foreseeable future. At present, China is viewed by many as a less-than-perfect partner in efforts to achieve a more effective Missile Technology Control Regime (MTCR), an agreement on a comprehensive test ban (CTB) treaty before 1996 and other non-proliferation and arms control initiatives. To understand why this is so, and to appreciate how the current transition in thinking among China's elites can help or hinder these initiatives over the long term, it is necessary to more clearly see the post-Cold War world and Asia from Beijing's perspective.

9 **Nuclear weapons supply and demand.** May, M.M. (Stanford Univ., CA (United States)). *American Scientist (United States);* 82(6): 526-537 (Nov-Dec 1994).

Controls on materials and technology have kept the nuclear-weapons club small, but only strong security arrangements will restrain demand. This paper covers both the history and the future concerns in nuclear weapons supply and demand. Specific areas discussed include the following: factors affecting supply; enriching uranium; plutonium; the new plutonium surplus; technologies and facilities needed to make a servicable weapon; the costs of becoming a nuclear arms nation; what international safeguards do; the demand for nuclear weapons. The final summary details four points which the author feels should be considered in support of a new nonproliferation policy: the U.S.-Japan and NATO alliances are the world's most important nuclear nonproliferation measures; further agreements among the nuclear-weapons states are needed to strengthen the 1995 extension of the Nuclear Non-proliferation Treaty; The nuclear nonproliferation regine is valuable even if not universally adhered to; a nuclear deterrent must be retained. 13 refs., 9 figs.

10 **Delusions v. conversion.** Khripunov, I. (Univ. of Georgia, Athens, GA (United States)). *Bulletin of the Atomic Scientists (United States);* 50(4): 11-13 (Jul-Aug 1994).

Russian defense conversion is a gloomy story, punctuated by only a few isolated successes. Overall industrial production in the first quarter of 1994 fell 27.4 percent below 1993 levels. Additionally the defense industry has been afflicted by the government's failure to pay its debts to the industry, which, in the first quarter of 1994 grew from 2.1 trillion to 4.7

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ARMS CONTROL RESEARCH

ABOUT THIS PUBLICATION

The Arms Control Database (ACD) has been developed to assist United States Government policymakers and supporting government and contractor researchers with analysis, characterization, and utilization of arms control measures as an element of United States national security policy.

This annotated supplementary bibliography presents unclassified citations to publications related to arms control selected from the Department of Energy's (DOE) Energy Science and Technology Database (EDB) and the Department of Defense's Defense Remote On-Line System (DROLS) published during 1994. The citations are maintained on the Arms Control Database by the Office of Scientific and Technical Information (OSTI) of the Department of Energy. The ACD unclassified citations are accessible online to qualified users. A separate classified segment is accessible online to cleared subscribers in cleared facilities. Within the ACD bibliography, abstracts are grouped by subject as shown in the table of contents. Within each subject area, the arrangement is by report number for reports and by reverse chronological order for nonreports. Entries in the subject index also facilitate access by subject, e.g., Arms Control/ International Agreements. Five indexes, each preceded by a brief description, are provided: Corporate Author, Personal Author, Subject, Contract Number, and Report Number.

This publication has been produced in support of and with the assistance of the Department of Energy's Office of Arms Control and Nonproliferation. The Office of Arms Control and Nonproliferation provides technical and analytical support for the interagency and international arms control process. The Department of Energy Headquarters point of contact for access to the ACD and publications deriving from it is DOE's Office of Arms Control and Nonproliferation (Richard A. Bowen, phone 202-586-2148). The technical contact at DOE's Office of Scientific and Technical Information is James D. Bales (phone 423-576-3960).

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CONTENTS

trillion rubles. Some members of government realize that the overmilitarized economy is burdensome and wasteful, and that post-Cold Ware reality necessitates a rapid reorientation to civilian purposes. Defense conversion has been called the first and foremost element in Russian economic reform. A converted defense industry must manufacture high-priority equipment in oil, gas, telecommunications, and space ventures. Russian economists estimate that modernization and conversion of the military-industrial comples will cost from $150 billion to $300 billion, which, Russia does not have. The lamentable state of Russia's defense conversion projects reflects the disarray of the overall economy. The government can turn the defense industry into an asset, both the task will require time, patience, money and innovation.

11 **Beating swords into plowshares.** *Atom (London) (United Kingdom);* (434): 39-40 (Jun-Jul 1994).

With the end of the Cold War and the consequent dismantling of United States and Russian nuclear weapons, comes the problem of what to do with the plutonium and highly enriched uranium thus produced. This surplus fissile material could pose a national and international security hazard and recent studies have stresses the need for mutual and cooperative monitoring of fissile material stocks. Long term proposals for disposal, such as burning the plutonium in nuclear plants, vitrifying it into high-level waste glass logs and burying it in deep boreholes in the Earth's surface are all considered with respect to safety and economic viability. (UK).

12 **Implications of defenses against tactical ballistic missiles.** Flax, A. *Arms Control Today (United States);* 24(4): 6-10 (May 1994).

The growing number of short- to medium-range ballistic missiles (SMBMs) in the inventories of many smaller states that have had recent or less recent armed conflicts with one another has been a source of concern to many countries. Inevitably this concern over ballistic missiles had been linked to their use as delivery vehicles for "weapons of mass destruction", a category that now includes nuclear, chemical and biological weapons. But it can be argued that this categorization is not particularly useful as a point of departure for discussions of ballistic missile defense (BMD) against SMBMs.

13 **Dangerous surplus.** Holdren, J.P. *Bulletin of the Atomic Scientists (United States);* 50(3): 39-41 (May-Jun 1994).

As a result of existing arms control reduction commitments, approximately 50 metric tons of weapon-grade plutonium is expected to become surplus in the United States–and a similar or larger amount in Russia–over the next 10 years. It is crucial that this surplus weapons plutonium be managed in a way that minimizes the danger that it will be re-used for weapons, does not lead to increased accessibility of civilian plutonium for weapons use, and meets reasonable standards for cost and human and environmental safety. The Committee on International Security and Arms Control (CISAC) of the National Academy of Sciences recently conducted an 18-month study for the U.S. government for methods of weapons plutonium management. This article summarizes the resulting report, which was released on January 24. The special security problems posed by plutonium are outlined. Three early phases of plutonium management emphasized by the report are discussed. Two candidate approaches for reducing the accessibility of weapons plutonium are described. One is to fabricate the weapons plutonium into mixed oxide fuel for reactors; the other is to mix the weapons plutonium with already reprocessed high-level radioactive waste for vitrification and long-term disposal. In either of the two approaches, the end result would be the dilution and the contamination of the weapons plutonium with a radioactive waste form. For both approaches, the ultimate destination of the plutonium would be a geologic repository.

14 **Let's use it.** Carter, L.J. *Bulletin of the Atomic Scientists (United States);* 50(3): 42-44 (May-Jun 1994).

This article addresses the question of how and under what international oversight weapons cores (plutonium "pits") may be transformed from weapons parts into a proliferation-resistant form. The author supports a position that the U.S. policy that has served to keep reprocessed plutonium out of civilian nuclear fuel needs to be modified for the disposal of weapons plutonium. Technical, economic, and political considerations of weapons plutonium management are described. Two means of dealing with weapons plutonium, as proposed by the National Academy of Science's Committee on International Security and Arms Control are discussed: (1) making plutonium into mixed oxide reactor fuel or (2) vitrification of the plutonium along with high-level nuclear waste.

15 **Let's not.** Makhijani, A. *Bulletin of the Atomic Scientists (United States);* 50(3): 44-45 (May-Jun 1994).

The historic report by the National Academy of Sciences (NAS) on the disposition of weapons plutonium, released January, 1994, considers excess military plutonium to be an economic and security liability. In this article, the recommendations of the NAS report are reviewed. Among the options dismissed by the NAS which the author believes warrant further consideration is the vitrification of plutonium alone, without radioactive waste. The possibility of processing vitrified plutonium is assessed. The author provides arguments to support his viewpoint that complete elimination of nuclear-weapons-usable materials is a necessary condition for achieving both nuclear nonproliferation and nuclear disarmament goals.

16 **No easy way to shackle the nuclear demon.** Taubes, G. *Science (Washington, D.C.) (United States);* 263(5147): 629-631 (4 Feb 1994).

This article explores the various options available for disposing of the plutonium from dismantled U.S. and Soviet Union nuclear weapons. The simplest solution is long-term storage (approx. 20 years) until a more satisfactory solution is found, such as the development of reactors designed to burn plutonium. This is unsatisfactory for political reasons, such as the instability of the Russian government, the perception that the plutonium could be recovered later for use in nuclear weapons, and security problems to prevent theft. Another option is mixing it with highly radioactive nuclear wastes, or mixing it with natural uranium to be processed through conventional nuclear power reactors. The plutonium would be transformed into something resembling high-level radioactive waste, which would be extremely hard to steal and process into weapons. A Presidential panel will make its recommendations for handling of the plutonium next October.

17 **A new vision is needed: A Chairman's perspective.** Castrioto Azambuja, M. de. *Disarmament (UN);* 17(2): 10-18 (1994).

The author discusses the importance in modern circumstances of conclusion of a comprehensive test ban treaty, of support and strengthening non-proliferation regime. 5 notes.

18 **The only alternative is the elimination of nuclear weapons.** Dubey, M. *Disarmament (UN);* 17(2): 77-96 (1994).

The history and present status of activities, including prospects for future activities, directed to complete elimination of nuclear weapons are discussed. 17 notes.

19 **The final stage of nuclear arms control - and how to achieve it.** Dean, J. *Disarmament (UN);* 17(2): 97-107 (1994).

The key components of the scheme for a final stage of nuclear arms control, such as, a fissile cut-off, drastic negotiated reduction of warheads and missiles, obligatory dismantling of reduced warheads and missiles, and obligatory transfer of the fissile material from reduced warheads to international monitoring are discussed.

3501 Policy, Negotiations, and Legislation

Refer also to citation(s) 1, 7, 8, 10, 12, 17, 118, 129, 143, 167

20 **Nuclear arms reduction, nuclear proliferation and high-level radioactive waste management.** Bullen, D.B. (Iowa State Univ., Ames, IA (United States)); McCormick, J.M. pp. 30-39 of High Level Radioactive Waste Management: Proceedings of the fifth annual international conference. Volume 1. American Nuclear Society, Inc., La Grange Park, IL (United States) (1994). pp. 373 From International high-level radioactive waste management conference; Las Vegas, NV (United States); 22-26 May 1994.

Surplus weapons grade fissile materials (highly enriched uranium (HEU) and plutonium) will become available in the near term due to recent reductions in nuclear weapons stockpiles in the United States and the Commonwealth of Independent States (the former Soviet Union). A brief review of the arms reduction agreements that precipitated the availability of surplus fissile materials and the current political efforts to manage these materials is presented. The status of implementation of recent significant agreements and the potential impact of these agreements on the inventory of weapons grade fissile materials is also discussed. The political problems associated with managing surplus fissile materials, including cooperative efforts between the U.S. and Russia, are reviewed. The technical options for utilization and/or disposal of these surplus fissile materials are presented including an estimate of the impact of these technologies on the wastes streams requiring disposal in a mined geologic disposal facility.

21 **Assuring the success of the non-proliferation treaty extension conference. Excerpts from the panel discussions.** Disarmament, Disarmament. NGO Committee on Disarmament, Inc. 121p. UN, New York, NY (United States) (Aug 1994). (CONF-9404223--: Assuring the success of the non-proliferation treaty extension conference, New York, NY (United States), 20-21 Apr 1994).

This publication presents excerpts from a conference organized by the NGO Committee on Disarmament Inc., in cooperation with the United Nations Centre for Disarmament Affairs, and covers the following issues: status of the comprehensive test ban treaty negotiations, fissile cut-off and ending production of nuclear weapons, how should nuclear weapons states pursue disarmament under Non-Proliferation Treaty (NPT), NPT extension: problems and prospects.

22 **Problems of the nuclear non-proliferation policy: Contributions to the international discussion.** (Probleme der nuklearen Nichtverbreitungspolitik: Beitraege zur internationalen Diskussion). Arbeitspapiere zur internationalen Politik, v. 83. Blix, H.; Butler, P. von; Fischer, W.; Caccia Dominioni, F.; Frick, H.; Gmelin, W.; Haeckel, E.; Lauppe, W.D.; Mueller, H.; Richter, B.; Stein, G. 162p. Europa-Union-Verl, Bonn (Germany) (May 1994). (In German).

The volume assembles a number of essays wherein basic problems of nonproliferation are identified and discussed in view of recent developments and future policy requirements. What is the role of multilateral institutions in the containment of nuclear proliferation? How are Western Europe's security needs to be reconciled with the tenets of the global nonproliferation regime? How can international safeguards be upgraded so as to increase confidence among states? What kinds of disciplinary instruments are needed for the international community to prevent an unco-operative state from gaining access to nuclear weapons? What kinds of obstacles stand in the way of smooth co-operation between the European Union and the United States in the nuclear field? How does the demise of global bipolarity impinge on the need to pursue an international nuclear order? The essays in this volume seek to combine structural analysis of conceptual issues with substantive policy recommendations. (orig./HP)

23 **H.R. 1948: A Bill to reduce the threat from nuclear facilities located in the former Soviet Union. Introduced in the House of Representatives, One Hundred Third Congress, First Session, April 29, 1993.** 6p. Government Printing Office, Washington, DC (United States) ([1994]).

This bill gives the President a directive to establish a program to reduce the environmental and national security threats from nuclear facilities located in the former Soviet Union.

24 **Evaluation of the U.S. strategic nuclear triad. Hearing before the Committee on Governmental Affairs, United States Senate, One Hundred Third Congress, First Session, June 10, 1993.** Senate Hearing 103-457. 131p. Government Printing Office, Washington, DC (United States) (1994).

These hearings address the issue of the US nuclear deterrent bassed on a triad of land-based, air-based, and sea-based ability to deliver nuclear weapons and how the decisions about such a policy were made. The goal is to apply this information to consideration about new weapons systems. Testimony is from the following: Chelimsky, General Accounting Office; Perry, Deputy Secretary of Defense. Written testimony and documents comprise a large part of the hearing.

25 **And weapons for all.** Hartung, W.D. 341p. HarperCollins Publishers, New York, NY (United States) (1994).

From review by Lora Lumpe, Federation of American Scientists, in Arms Control Today, Vol. 24, No. 6 (Jul-Aug 1994).

The author delivers an indictment of arms export policymaking by the few. Details are given on how, the United States (U.S.) government and corporate foreign policy establishments have sold out U.S. and international security for profit, bureaucratic interests and short-term foreign policy gains. In 300 pages the author details how consecutive administrations have circumvented congressional and public accountability and thwarted the democratic progress through secretive arms supply relationships.

26 **The United Nations Disarmament Yearbook. V. 18: 1993.** 429p. UN, New York, NY (United States) (1994).

This volume of the Yearbook contains a review of the main developments and negotiations in the field of disarmament together with a brief history of the major issues, including aspects of nuclear arms limitation, nonproliferation, disarmament and related issues. Tabs.

27 **Ending Europe's wars: The continuing search for peace and security.** Dean, J. 441p. The Twentieth Century Fund Press, New York, NY (United States) (1994).

From review by Stanley R. Sloan, in Arms Control Today, Vol. 24, No. 8 (Oct 1994).

The author provides a stimulating analytical tour through the landscape of Europe's emergence from the Cold War. The Western allies were challenged to bring a sense of order to what had become a very disorderly international system, particularly in Europe, after the Soviet Union and Warsaw Pact crumbled. The author addresses three long term issues which threaten European security. The book is packed with ideas and recommendations for peace in Europe that should be carefully considered by current and future policy-makers.

28 **Wisdom prevails in Kiev: Global security wins.** Keeny, S.M. Jr. *Arms Control Today (United States);* 24(10): 2 (Dec 1994).

The Ukrainian parliament's overwhelming vote (301-8) approving accession to the nuclear Non-Proliferation Treaty (NPT), which demonstrated a national consensus for a future without nuclear weapons rather than the vain glorious pursuit of nuclear grandeur, has greatly strengthened the nuclear non-proliferation regime and global security. Ukraine's accession to the NPT, coming directly on the heels of the US-North Korean agreement closing down Pyongyang's nuclear weapons program, should ensure the indefinite extension of the NPT at the April 1995 conference.

29 **Third PrepCom highlights uncertainties: NPT showdown ahead.** Cirincione, J. *Arms Control Today (United States);* 24(10): 3-6 (Dec 1994).

Indefinite and unconditional extension of the nuclear Non-Proliferation Treaty (NPT), favored by the United States, was considered a sure thing by many observers just a few months ago. Now it looks considerably less certain after a contentious and frustrating September meeting in Geneva in preparation for the April 1995 NPT extension and review conference. The buildup to the 1995 meeting has become a lightening rod for conflicting national agendas and competing disarmament strategies. It now appears impossible to achieve indefinite extension of the NPT by consensus of all 166 states party to the treaty, and even winning indefinite extension by majority vote (which is the current US strategy), is by no means assured.

30 **Fissile material smuggling: German politics, hype and reality.** Mueller, H. *Arms Control Today (United States);* 24(10): 7-10 (Dec 1994).

The spy novel nightmare scenarios of nuclear smuggling have become reality, and much of the recent news has focused on Germany. But these events must be put in perspective, and a number of apparent "facts" must be examined more carefully. For example, while authorities in Germany have seized weapons-usable material in various incidents that have captured international attention, none of this material is from nuclear weapons or weapons production facilities. Moreover, despite the fact that the number of criminal cases has risen, the quantity of "loose" weapons-usable material is still not significant. Nor are there any indications so far that powerful criminal organizations or buyers from nuclear-ambitious "rogue" states are involved. Rather, the incidents so far involve individuals or small groups of criminals who found that their "buyers" were, more often than not, German security agents working "sting" operations to trap the smugglers and black marketeers or journalists working on a "big story."

31 **Conventional arms control initiatives: Russia as a special case.** Khripunov, I. (Univ. of Georgia, Athens, GA (United States)). *Arms Control Today (United States);* 24(10): 11-16 (Dec 1994).

The post-Cold War period has provided several spectacular breakthroughs in what seemed to be intractable arms control problems that were pushing the world to the brink of global disaster. One of the serious remaining gaps is the still largely unrestricted flow of conventional weapons, whose increasing sophistication and overkill potential is understandably a matter of growing concern. In addition to recognizing the continued priority of curbing the spread of weapons of mass destruction and drastically reducing their stockpiles, the time has come to engage major weapons exporters in developing new international understandings and mechanisms to stop the flood of conventional arms on the global market and to drastically curb conventional arms transfers.

32 **Ukraine accedes (finally) to NPT; opens way to START reductions.** Lockwood, D. *Arms Control Today (United States);* 24(10): 17 (Dec 1994).

After years of delay, the Ukrainian parliament (Rada) voted November 16 to accede to the nuclear Non-Proliferation Treaty (NPT) as a non-nuclear-weapon state by an overwhelming 301-8, clearing the way for the long-awaited entry into force of START I. The vote also clears the way for the US Senate and Russian Parliament to begin deliberating on the ratification of START II and strengthens prospects for indefinite extension of the NPT at the 1995 conference. The timing of the vote was driven by Ukrainian President Leonid Kuchma's state visit to Washington November 22-23.

33 **U.S., IAEA and North Korea move to implement nuclear deal.** Wolfsthal, J.B. *Arms Control Today (United States);* 24(10): 18 (Dec 1994).

US officials completed a week of technical talks November 19 in North Korea on options for interim safe storage of

8,000 spent nuclear fuel rods now in a cooling pond at the Yongbyon nuclear facility. On November 1, Pyongyang announced it was already "taking practical steps" to implement the October 21 US-North Korean framework agreement by halting all reprocessing and construction activities at Yongbyon and construction activities at Yongbyon and construction of two new reactors. The delegation made a first-ever visit by US officials to Yongbyon during its visit.

34 **Agreed framework between the United States of America and the Democratic People's Republic of Korea.** Gallucci, R.L.; Ju, Kang Sok. *Arms Control Today (United States);* 24(10): 19 (Dec 1994).

Delegations of the Governments of the United States of America (US) and the Democratic People's Republic of Korea (DPRK) held talks in Geneva from September 23 to October 21, 1994, to negotiate an overall resolution of the nuclear issue on the Korean Peninsula. Both sides reaffirmed the importance of attaining the objectives contained in the August 12, 1994 Agreed Statement between the US and the DPRK and upholding the principles of the June 11, 1993 Joint Statement of the US and the DPRK to achieve peace and security on a nuclear-free Korean peninsula.

35 **U.S. and Soviet/Russian strategic nuclear forces: Past, present and projected.** *Arms Control Today (United States);* 24(10): 29 (Dec 1994).

The Defense Department recently released new information about the configuration of US forces under START II. The table below shows past, present and projected US and Soviet/Russian strategic warheads, which under START II will ultimately decline by about two-thirds from 1990 levels. This will not occur until the US Senate and Russian Parliament approve the agreement. A major stumbling block was cleared November 16 when Ukraine voted to accede to the NPT as a non-nuclear-weapons state.

36 **Official announcement of an extension of the territorial applicability of the Treaty Prohibiting the Positioning of Nuclear Weapons and other Mass Destruction Weapons on the Sea Floor or in the Sea Bed. As of November 30, 1994.** *Bundesgesetzblatt, Teil 2 (Germany);* (63): 3866 (31 Dec 1994). (In German).

Short communication NUCLEAR WEAPONS/marine disposal; INTERNATIONAL AGREEMENTS; NUCLEAR DISARMAMENT; ALGERIA; PHILIPPINES; SLOVENIA; IMPLEMENTATION; ENFORCEMENT

37 **A triumph of quiet diplomacy.** Keeny, S.M. Jr. *Arms Control Today (United States);* 24(9): 2 (Nov 1994).

The new US agreement with North Korea is a breakthrough in the international effort to eliminate the most serious threat to the non-proliferation regime. Despite mutual mistrust, the two sides have, by quiet diplomacy, crafted an ingenious agreement that terminates Pyongyang's current and future nuclear weapons program in return for economic benefits and an opportunity to join the international community.

38 **Is Japan a military threat to Asia?.** Halloran, R. *Arms Control Today (United States);* 24(9): 12-17 (Nov 1994).

The foreign minister of Japan, Yohei Kono, stood in the UN General Assembly in September and sought to reassure delegates that Japan would not again employ military power in the international area. "Japan does not, nor will it, resort to the use of force prohibited by its constitution," Kono said, "Japan will remain resolutely a nation of peace."

39 **The North Korean nuclear crisis: From stalemate to breakthrough.** Harrison, S.S. *Arms Control Today (United States);* 24(9): 18-20 (Nov 1994).

The Clinton Administration is pursuing a negotiated solution to the nuclear issue with North Korea that involves both economic and political incentives. But Pyongyang remains deeply suspious that South Korea is scheming to absorb the North and with United States and Japanese help in a repition of the German model. This has been and will continue to be the key factor conditioning Pyongyang's approach to the nuclear problem.

40 **The status of US, Russian and Chinese nuclear forces in Northeast Asia.** Lockwood, D. *Arms Control Today (United States);* 24(9): 21-24 (Nov 1994).

The current and future deployment of nuclear weapons in Northeast Asia by the United States, Russia, and most particularly, China - each with vital interests in the region - will play a critical role in determining how the region's smaller or weaker states respond. The calculus of deterrence and defense postures of the three declared nuclear-weapon states with interests in the region are inextricably interrelated and will also affect the way security planners in the states of East Asia, which are increasingly able to afford expensive new weapons systems, make budgetary and military calculations. As with so many things in that dynamic region, US, Chinese and Russian nuclear strategies, programs and force deployments have been in a state of transition in recent years. The nuclear policies and deployments of all three states will have a major impact on prospects for stability and possible arms control efforts in East Asia.

41 **U.S., Pyongyang reach accord on North's nuclear program.** Wolfsthal, J.B. *Arms Control Today (United States);* 24(9): 25, 32 (Nov 1994).

US and North Korean negotiators signed an agreement on October 21 that will, when implemented, eliminate North Korea's ability to produce nuclear weapons and bring North Korea into full compliance with the nuclear Non-Proliferation Treaty (NPT). President Bill Clinton publicly praised the agreement following an October 18 White House meeting where his top advisors met with chief negotiator Robert Gallucci and unanimously endorsed the deal.

42 **Joint statement on strategic stability and nuclear security by the presidents of the United States and Russia.** *Arms Control Today (United States);* 24(9): 31-32 (Nov 1994).

Presidents Clinton and Yeltsin underscored that, with the end of the Cold War, major progress has been achieved with regard to strengthening global strategic stability and nuclear security. Both the United States and Russia are significantly reducing their nuclear forces. Important steps have been taken to detarget strategic missiles. Multilateral negotiations on a comprehensive nuclear test ban have begun. The Presidents noted the key role of the Non-Proliferation Treaty in ensuring global stability.

43 **Can the test ban be saved?.** Keeny, S.M. Jr. *Arms Control Today (United States);* 24(8): 2 (Oct 1994).

The Geneva negotiations on a comprehensive test ban (CTB) treaty recessed on September 7 for five months without making any significant progress. The heavily "bracketed"

draft treaty revealed that the negotiators from 37 countries had failed to agree on a single major issue. Little chance remains to complete the treaty before the nuclear Non-Proliferation Treaty (NPT) review and extension conference begins next April 17. The prospect of continued gridlock does not auger well for the NPT's indefinite extension - a principal US security policy objective - since many non-nuclear-weapon states consider the test ban the litmus test of the nuclear-weapon states' willingness to meet their obligations under Article VI of the NPT.

44 **Transparency in nuclear arms: Toward a nuclear weapons register.** Mueller, H. (Peace Research Institute, Frankfurt (Germany)). *Arms Control Today (United States);* 24(8): 3-7 (Oct 1994).

In his press conference to present a "10-point non-proliferation initiative" last December, German Foreign Minister Klaus Kinkel included a proposal calling for an international register for nuclear weapons, analogous to the UN Conventional Arms Register. When German diplomats explained the initiative to their allies in London, Paris and Washington, they were sharply rebuffed. Apparently the three nuclear-weapon states were strongly opposed to the idea and therefore discouraged Germany from pursuing it further in the Conference on Disarmament (CD) in Geneva, where the ad hoc group on transparency in armaments would be an appropriate forum for further discussion. Faced with these cold responses, German diplomats shelved the idea for the time being and concentrated on initiatives that promised better chances for agreement, such as the comprehensive test ban (CTB) treaty currently under discussion, a fissile material cutoff agreement and an international plutonium management regime.

45 **The UN Register of Conventional Arms: The debate on the future issues.** Wagenmakers, H. *Arms Control Today (United States);* 24(8): 8-13 (Oct 1994).

One of the first truly cooperative global security-building measures, brought into being largely as a result of the costly Gulf War of more than three years ago, is the UN Register of Conventional Arms - a transparency measure designed to contribute to the prevention of destabilizing accumulations of arms. The register has been in operation for over two years, and while it clearly shows great promise as an instrument that will increase regional stability, decrease tensions and help prevent conventional arms races, it is equally clear that if it is to achieve its full potential, work must continue to refine its provisions for the reporting categories, expand its scope and increase the level of participation, and to deal with a number of unresolved issues.

46 **A treaty to ban nuclear smuggling: The next step in nuclear material control?.** Carnahan, B.M. (Science Applications International Corp., McLean, VA (United States)); Smith, J.R. *Arms Control Today (United States);* 24(8): 14-17 (Oct 1994).

Since the demise of the Soviet Union, reports have continued to surface that weapons-usable nuclear material has been smuggled out of former Soviet territory into the hands of proliferant states. So far, few examples of nuclear smuggling have involved serious quantities of weapons-usable material, and much purported smuggling has involved attempted fraud rather than an effort to transfer fissile material. In no instance has an actual transfer to a potential proliferant state been verified.

47 **U.S. weighs response to Russian proposal on ATBM demarcation.** Lockwood, D. *Arms Control Today (United States);* 24(8): 18 (Oct 1994).

With the next round of US-Russian talks in the Standing Consultative Commission (SCC) slated to begin the week of October 10, the Clinton administration is trying to formulate a response to Moscow's new proposal on anti-theater ballistic missile (ATBM) testing and deployment.

48 **The theater missile defense threat to US security.** Keeny, S.M. Jr. *Arms Control Today (United States);* 24(7): 3-7 (Sep 1994).

The Clinton administration has embraced a major program to develop a family of theater missile defense (TMD) systems to protect US forces and allies overseas. The large scale of the undertaking is reflected in Congressional Budget Office estimates that currently planned development and procurement alone will cost around $50 billion through the year 2010. This figure could easily double if the proposed advanced-capability systems are actually deployed and the historical pattern of cost escalation of high-technology programs prevails.

49 **Shooting down the ABM Treaty.** Mendelsohn, J.; Rhinelander, J.B. *Arms Control Today (United States);* 24(7): 8-10 (Sep 1994).

The Clinton administration is on a path to undermine the Anti-Ballistic Missile (ABM) Treaty by proposing "clarifications" to the treaty that would permit the deployment of an extensive, highly capable anti-theater ballistic missile (ATBM) defense system.

50 **Theater missile defense programs: Status and prospects.** Pike, J. *Arms Control Today (United States);* 24(7): 11-14 (Sep 1994).

The Clinton administration now calls the Strategic Defense Initiative (SDI) the ballistic missile defense program. But the names have simply been changed to protect the guilty - the new program exhibits substantial continuity with the old in technology and goals. While acronyms have been changed, many of the programs continued by the Clinton administration date from the Reagan or Bush eras. And most strikingly, the Clinton administrations' ambitions for a virtually perfect defense against theater ballistic missiles harken to the unattainable goals for strategic defense initially set by President Reagan over a decade ago.

51 **Atlantic impasse.** Berkhout, F.; Walker, W. *Bulletin of the Atomic Scientists (United States);* 50(5): 15-17 (Sep-Oct 1994).

Nuclear trade relations between the United States and The European Union are in danger of falling apart. The U.S. - Euratom Cooperation agreements, under which trade in nuclear materials and technology has been conducted since the 1950s, lapse at the end of 1996. Negotiations to renew the agreement, under way since mind-1992, are in trouble. Failure to agree on a new accord will have serious consequences for all nuclear trade. The issue of 'prior consent' is the principal striking point. American negotiators insist that, in the future, Europeans must obtain permission of the U.S. government before they can separate, use, or transfer plutonium from fuel that originated in the U.S. European negotiators do not want to accept greater U.S. control over their nuclear activities at a time when the mood in Washington is so firmly against reprocessing. European attitudes are

also colored by commercial considerations. The European nuclear industry has supported the European Union's tough line. The spetacle of allies and supporters of the Nuclear Non-Proliferation Treaty (NPT) squabbling over each others' rights to control civil nuclear activities would send the wrong signal to the NPT Extension Conference. This disput has the potential for boiling up into a highly damaging standoff in which there will only be losers.

52 **The Clinton plan for theater missile defenses: Costs and alternatives.** Mosher, D.; Hall, R. *Arms Control Today (United States);* 24(7): 15-20 (Sep 1994).

Since the Gulf War, the Department of Defense has placed a high priority on developing defenses against theater ballistic missiles (TBMs). Over the past two years the Clinton administration has redirected the focus of the Ballistic Missile Organization (BMDO, formerly the Strategic Defense Initiative Organization) away from a national missile defense system and toward the development of theater missile defenses (TMDs). But the plan put forward by the administration is expensive - as much as $50 billion through the year 2010 - and it also raises several important issues about compliance with the Anti-Ballistic Missile (ABM) Treaty. But other approaches to TMD would address some of these cost and compliance concerns, so it is worthwhile to look at several alternatives and analyze their costs and effects on capability.

53 **U.S., North Korea sign accord on "resolution" of nuclear crisis.** Wolfsthal, J.B. *Arms Control Today (United States);* 24(7): 23, 30-31 (Sep 1994).

Following high-level talks in Geneva from August 5-12, US and North Korean officials signed an "agreed statement" outlining the basis for a "final resolution of the nuclear issue." In a news conference after the talks, Assistant Secretary of State and chief negotiator Robert Gallucci called the agreement "a first step" that "we think...provides a basis on which we can build and go farther." Several key issues left unresolved in the initial agreement are to be addressed during expert-level talks before high-level negotiations resume September 23.

54 **The soft-kill fallacy.** Aftergood, S. *Bulletin of the Atomic Scientists (United States);* 50(5): 40-45 (Sep-Oct 1994).

Dozens of non-lethal weapons have been proposed or developed, mostly in laboratory-scale models. They encompass a broad range of technologies, including chemical, biological, kinetic, electromagnetic, and accoustic weapons, as well as informational techniques such as computer viruses. 'Non-lethal weapons disable or destroy without causing significant injury or damage,' asserted Undersecretary of Defense Paul Wolfowitz in a March 1991 memorandum. The idea of 'non-lethal' weapons is politically attractive and purposively misleading. Some of these 'non-lethal' weapons may violate treaties. Four international treaties are particularly relevant and discussed in some detail. A list of weapons of this nature is also provided. But basic political, legal and strategic questions about the utility of the non-lethal thrust remains unanswered and sometimes unasked. 15 refs.

55 **Transformation of the Soviet space program after the cold war.** Tarasenko, M.V. *Science and Global Security (United States);* 4(3): 339-361 (Aug 1994).

Changes in the management of the space program and the operational status of various systems in the former Soviet Union are examined with particular emphasis on defense-related space systems. After the break-up of the Soviet Union, Russia assumed general responsibility for the entire scope of Soviet space activity. Space program management was re-organized to separate military and civilian activities. Russia is committed to maintaining military space capabilities, however, its top priority is now the conversion of military space technology for civilian uses, including global environmental problems.

56 **Official announcement of the agreement concluded by Germany and the Ukraine, for cooperative activities for solving problems in connection with the destruction of nuclear weapons. As of July 11, 1994.** *Bundesgesetzblatt, Teil 2 (Germany);* (37): 1291-1292 (13 Aug 1994). (In German).

Short communication NUCLEAR DISARMAMENT/bilateral agreements; UKRAINE; FEDERAL REPUBLIC OF GERMANY; NUCLEAR WEAPONS; IMPLEMENTATION; INTERNATIONAL COOPERATION

57 **North Korea: War drums or peace pipes?.** Keeny, S.M. Jr. *Arms Control Today (United States);* 24(6): 2 (Jul-Aug 1994).

President Clinton has wisely seized the opportunity, presented by former President Jimmy Carter's meeting with North Korea leader Kim Il Sung, for renewed negotiations with Pyongyang on its nuclear program. While a successful outcome cannot be guaranteed, both sides have backed off the mounting confrontation that threatened to lead to either the emergence of a nuclear North Korea or a second Korean war.

58 **The doctrine of the nuclear-weapon states and the future of non-proliferation.** Panofsky, W.K.H.; Bunn, G. *Arms Control Today (United States);* 24(6): 3-9 (Jul-Aug 1994).

Less than a year remains before the critical conference in April 1995 to review and extend the nuclear Non-Proliferation Treaty (NPT), the main international barrier to the proliferation of nuclear weapons. This is a critical moment for the United States. With the end of the Cold War, the likelihood of nuclear war with the states of the former Soviet Union has been radically reduced, but there is greatly increased concern over the potential threats from states or sub-state groups seeking to develop or acquire nuclear weapons and other weapons of mass destruction.

59 **Thomas Graham, Jr.: Preparing for the 1995 NPT Conference.** *Arms Control Today (United States);* 24(6): 10-13 (Jul-Aug 1994).

With attention increasingly focused on the critical nuclear Non-Proliferation Treaty (NPT) extension and review conference beginning in April 1995, Thomas Graham, Jr. plays a key role in negotiations to gain indefinite treaty extension during voting at the conference. He has been Arms Control and Disarmament Agency (ACDA) general counsel since 1983, served as acting director from January to November 1992 and since November 23, 1992, has been acting deputy director. Among other assignments, he served as legal advisor to the US SALT II delegation and senior ACDA representative to the US Intermediate-Range Nuclear Forces

delegation in 1981-82. He was interviewed May 26 by Jack Mendelsohn and Jon B. Wolfsthal.

60 **Ukraine: Europe's next crisis?.** Larrabee, F.S. (RAND Corp., Santa Monica, CA (United States)). *Arms Control Today (United States);* 24(6): 14-19 (Jul-Aug 1994).

The emergence of an independent Ukraine was one of the most important geopolitical results of the collapse of the former Soviet Union. It dramatically changed the geostrategic map of Europe, creating a critical strategic buffer between Russia and Europe, especially Eastern Europe. But two years after independence, Ukraine is in the midst of a severe political and economic crisis, and engaged in a series of elections that could have major and immediate consequences not only for Ukraine's political future and security orientation, but for Western policy. Parliamentary elections were held in March, but runoff elections are needed for about one-quarter of the seats, and presidential elections will be held June 26.

61 **Early retirement for weaponeers?.** Weisman, J. *Bulletin of the Atomic Scientists (United States);* 50(4): 16-22 (Jul-Aug 1994).

Department of Energy's Lawrence Livermore Laboratory's once-vital nuclear weapons division is now in dire straits. The laboratory was established in 1952, during the titanic struggle over the hydrogen bomb, has grown steadily from $7 million to its peak of $1.1 billion in 1991. The future for key members of their most experienced weapons design team is uncertain. Over the past two years, Livermore's operating budget has fallen by 12.5 percent or $127.6 million. Nearly 750 employees, 10 percent of the work force, accepted early retirement offers last year. Further budget cuts will force another 300 to 600 personnel out by the end of 1995. The future resides in the U.S. Congress.

62 **Openness, transparency, and enhanced safeguards.** *JNMM (Journal of the Institute of Nuclear Materials Management) (United States);* 22(4): 22-23 (Jul 1994).

Much confusion exists regarding the use of the terms openness and transparency in the context of improved International Atomic Energy Agency (IAEA) safeguards pursuant to the Nuclear Nonproliferation Treaty (NPT). While the two are often used interchangeably, they are quite different aspects of the overall NPT safeguards approach. To clarify the terms, Standing Advisory Group on Safeguards Implementation (SAGSI) describes transparency as a glass house with an interior that can be viewed from a distance, and openness is a brick house that one can enter. While this analogy is helpful, it is not entirely satisfactory. Transparency is not a synonym for openness; it is a function or a result of openness. There can be no transparency without openness first, thus the issue of improved openness should be a prime consideration in ongoing international efforts to strengthen the current NPT safeguards system. The safeguards system administered by the IAEA pursuant to the NPT works because the treaty's signatories have a common commitment to nuclear nonproliferation and have agreed to common guidelines to verify compliance with this commitment. Nevertheless, a need to improve existing safeguards was expressed at the 1990 NPT Review Conference. This perceived weakness in the NPT safeguards system may be rooted in the lack of a common definition among Member States as to what constitutes openness. In this context, the issue of openness could have ramification not only for the effectiveness of the international community's nuclear nonproliferation efforts but also for the activities of the IAEA in terms of the resources required for the effective administration of the current NPT safeguards system. Some adjustment of the IAEA's NPT safeguards activities should occur in the form of a redirection of current efforts, an augmentation of current resources, or both.

63 **Shopping spree softens test-band sorrows.** Collina, T.Z. (Institute for Science and International Security, Washington, DC (United States)); Kidder, R.E. *Bulletin of the Atomic Scientists (United States);* 50(4): 23-29 (Jul-Aug 1994).

The Department of Energy, over the past year, has proposed a $2 billion wish list of new facilities to help conduct non-nuclear tests on nuclear weapons by their weapons laboratories. Surprisingly, some comprehensive nuclear test ban (CTB) partisans seem to support this approach. When a CTB treaty is finally submitted to the Senate for ratification, convervative senators will want assurances that the United States is not letting its nuclear stockpile fall apart. However, letting the laboratories proceed on the new hardware and facilities issue could be of concern to other nations and stall CTB negotiations. The new stockpile stewardship program was designed to help the laboratories maintain the nuclear arsenal, and the necessary expertise, without nuclear tests. The weapons laboratories are already equipped to conduct sophisticated tests. We can have a CTB and still maintain high confidence in the nuclear arsenal without spending billions on new facilities.

64 **Non-signatories to the nuclear Non-Proliferation Treaty.** *Arms Control Today (United States);* 24(6): 28 (Jul-Aug 1994).

The nuclear Non-Proliferation Treaty (NPT) is the most widely adhered-to arms control agreement in history, with 163 states having joined since it was opened for signature in 1968. In April 1995, NPT members will meet to decide by majority vote "whether the Treaty shall continue in force indefinitely, or shall be extended for an additional fixed period or periods."

65 **South Africa and the affordable bomb.** Albright, D. (Institute for Science and International Security, Washington, DC (United States)). *Bulletin of the Atomic Scientists (United States);* 50(4): 37-47 (Jul-Aug 1994).

F.W. de Klerk's announcement in March 1993 that South Africa has secretly developed a small nuclear arsenal, and junked it, was starting in its candor. The bedrock question is why South Africa developed and built seven fission weapons in the first place. The scientists, engineers, and policy-makers claim that weapons were never intended for military use or integration into the country's military forces. Instead they claim that the strategy was bombs for political purposes. The strategy was designed to bring Western governments to South Africa's aid in the event of an overwhelming attack by Soviet inspired military forces then in southern Africa. Shortly after de Klerk became president in 1989, the ordered a halt to the nuclear weapons program in anticipation of acceding to the Nuclear Non-Proliferation Treaty (NPT). On July 10, 1991, South Africa became a member of the NPT. The program developing the seven nuclear weapons is discussed in some detail for various phases of the project. 13 refs.

66 **What price counterproliferation?.** Keeny, S.M. Jr. *Arms Control Today (United States);* 24(5): 2 (Jun 1994).

The Clinton administration is promoting "counterproliferation" as a central component of is defense posture. The new program calls for a broad range of actions in anticipation of the failure of the non-proliferation regime, including specialized munitions and massive expenditures for an anti-tactical ballistic missile (ATBM) system. In the absence of any new proliferation threat, how much should be spent for this purpose?

67 **Miguel Marin-Bosch: Achieving a comprehensive test ban.** *Arms Control Today (United States);* 24(5): 3-7 (Jun 1994).

After years of delay, serious negotiations on a comprehensive test ban (CTB) treaty began in Geneva in January, and there are indications that rapid progress could come during the next few months, with important implications for other arms control treaties. Ambassador Miguel Marin-Bosch is a career diplomat in the Mexican foreign service who has followed arms control issues in Geneva and New York since 1969. United Nations Conference on Disarmament (CD) in Geneva and Chairman of the Ad Hoc Committee on a CTB. His April 26 interview with Arms Control Today took place in Washington between formal sessions of the CD, where, as chairman, he is expected to soon present a draft CTB treaty as a focal point for further negotiations and discussions.

68 **Disposing of chemical warfare agents and munitions stockpiles.** Peterson, C.R. (Massachusetts Institute of Technology, Cambridge, MA (United States)). *Arms Control Today (United States);* 24(5): 8-13 (Jun 1994).

There are at least two important reasons to dispose of US chemical warfare agents and munitions stockpiles without deliberate delay. One is the laudable intent to rid the world of these dangerous weapons of mass destruction. The other is the pragmatic observation that the aging stockpile is becoming increasingly dangerous for US citizens. In terms of laudable intent, the United States has an opportunity to lead by example, and as for the threat to its citizens, it has the obligation to act responsibly.

69 **Forging an effective biological weapons regime.** Pearson, G.S. *Arms Control Today (United States);* 24(5): 14-17 (Jun 1994).

In September, signatories to the 22-year-old Biological and Toxin Weapons Convention (BWC) will gather in Geneva to carefully study scientific and technical evaluations of measures by a panel of international governmental experts that are designed to strengthen the convention's implementation and verification regime. Before that meeting, it is timely to examine these evaluations and the goals and underlying approach of proposed measures to strengthen the BWC in the context of the threat posed by such weapons and earlier efforts to establish an effective regime.

70 **The continuing North Korean nuclear crisis.** *Arms Control Today (United States);* 24(5): 18-22 (Jun 1994).

The confrontation between North Korea and the International Atomic Energy Agency (IAEA) over the right to fully inspect Pyongyang's nuclear facilities has continued for over a year now. Recent diplomatic activities and statements have prompted a new look at the ongoing crisis. On May 5 the Arms Control Association (ACA) held a news conference to examine North Korea's refusal to abide by its commitments under the nuclear Non-Proliferation Treaty (NPT) and to assess recent developments.

71 **Chronology of US-Soviet-CIS nuclear relations.** *Arms Control Today (United States);* 24(5): 32-33 (Jun 1994).

Since the signing of the first Strategic Arms Reduction Treaty (START I), a number of important events related to nuclear weapons in the former Soviet Union have taken place. A chronology of key developments over the past three years is discussed.

72 **Look before you LEAP.** Keeny, S.M. Jr. *Arms Control Today (United States);* 24(4): 2 (May 1994).

Almost unnoticed, the Clinton administration is quietly seeking to persuade Russia to join in a reinterpretation of the Anti-Ballistic Missile (ABM) Treaty that could have extremely adverse consequences for U.S. security. Under the guise of "clarifying" the dividing line between strategic ballistic missile defenses, which are covered by the treaty, and tactical defenses so permissive that systems with significant capability against strategic missiles couid legally be deployed. Consequently, systems that also violate other treaty provisions, including the ban on mobility, could be deployed in unlimited numbers. Opening this gaping loophole in the ABM Treaty could block further reductions in strategic warheads below START II levels. This new barrier to reducing nuclear arsenals would undercut U.S. efforts to achieve an indefinite extension of the Nuclear Non-Proliferation Treaty.

73 **Strategic nuclear policy and non-proliferation.** Warnke, P.C. *Arms Control Today (United States);* 24(4): 3-5 (May 1994).

A year from now, in April of 1995, a conference will be convened to consider the extension of the nuclear Non-Proliferation Treaty (NPT). This is mandated by the treaty itself, which provides that 25 years after its effective date, March 5, 1970, the parties are to meet to determine the length of any extension.

74 **Strategic nuclear forces of the United States and the commonwealth of independent States.** Mendelsohn, J.; Lockwood, D. *Arms Control Today (United States);* 24(4): 25-26 (May 1994).

With the end of the Cold War, the reductions in defense budgets, and anticipation of the entry into force of the first Strategic Arms Reduction Treaty (START I), the United States and the Commonwealth of Independent States (CIS) have been retiring older strategic nuclear systems more rapidly than they are replacing them. The net effect has been a decrease in the overall size of U.S. and CIS strategic arsenals. The tables below provide a snapshot of U.S. and Commonwealth strategic nuclear arsenals as of April 1994.

75 **New threats to the NPT and the ABM Treaty.** Mendelsohn, J. *Arms Control Today (United States);* 24(3): 2 (Apr 1994).

Although the last few months have seen a number of positive steps in arms control-the start of negotiations for a comprehensive test ban treaty, the extension of the U.S. nuclear testing moratorium through September 1995, an ingenious trilateral deal with Kiev and Moscow to move along the denuclerization of Ukraine, and agreement in principle to the reciprocal monitoring of U.S. and Russian plutonium

storage facilities-two potential policy changes in Washington could undercut these developments.

76 Highly capable theater missile defenses and the ABM Treaty. Gronlund, L.; Lewis, G.; Postol, T.; Wright, D. *Arms Control Today (United States);* 24(3): 3-8 (Apr 1994).

Since 1972 the Anti-Ballistic Missile (ABM) Treaty has been one of the fundamental building blocks of U.S.-Soviet and U.S.-Russian arms control efforts. By severely restricting the deployment of defensive systems that could undermine deterrent capabilities, the ABM Treaty removed a potential incentive to increase strategic nuclear forces and allowed substantial force reductions to be negotiated in the START I and II agreements. Although the Cold War has ended, the treaty may still have important roles today and in the future. In particular, future deep reductions in U.S. and Russian strategic forces, as well as in the nuclear forces of other countries, may be impossible without the assurance granted by the treaty.

77 The North Korean missile program: How advanced is it?. Wright, D.; Kadyshev, T. *Arms Control Today (United States);* 24(3): 9-12 (Apr 1994).

For the past three years there have been increasing numbers of reports that North Korea is developing a 1,000-1,300-kilometer range missile generally referred to as the NoDongg-1. Pyongyang's missile program has generated international concern because of North Korea's potential nuclear capabilities, its proximity to South Korea and Japan and its reported missile sales to Iran, Syria and Libya. In June 1993, Japanese and South Korean wire services reported that North Korea had test fired several missiles into the Sea of Japan in late May, at least two of which were though to be NoDong-1 missiles. A missile with a 1,300-kilometer range would give North Korea the capability to reach all of Japan, and give Iran and Libya the capability to reach all of Israel.

78 Non-proliferation and national security. Gallucci, R.L. *Arms Control Today (United States);* 24(3): 13-16 (Apr 1994).

The disappearance of the Soviet Union changed the proliferation problem from one state to four states with nuclear weapons. Their has been much effort to bring Belarus, Kazakhstan and the Ukraine into the Non-Proliferation Treaty. Another aspect was control and accounting for plutonium and highly enriched uranium. Finally, there is the concern about technology and what could be called 'rain-drain' with the scientists who made the weapons, looking for work. Other areas of real challenge of proliferation is South Asia, including Kashmir, Pakistan and India. Policy has been to engage the North Koreans in discussion with the objective of getting them back in the Non-Proliferation Treaty, and getting them to fully accept the International Atomic Energy Agency's safeguards. Further, the United States is advancing the notion of an international and universal convention to which all states would adhere, ending forever the production of fissile material for weapons.

79 Experts endorse chemical arms pact, but some worry about implementation. Ember, L.R. (C and EN, Washington, DC (United States)). *Chemical and Engineering News (United States);* 72(16): 16-20 (18 Apr 1994).

As the Senate deliberates ratification of the chemical weapons treaty, chemical warfare experts are debating its merits in private forums. The latest exchange took place recently at the Washington-based Center for Strategic and International Studies (CSIS). Conference organizer and CSIS analyst Brad Roberts called on nearly 200 government officials, policy analysts, and chemical industry representatives to probe beneath the accumulation of inherited conventional wisdom to understand the processes, challenges, and stakes associated with implementing the Chemical Weapons Convention. Within 30 days of the treaty's entry into force, the US and its civilian chemical industry will be making declarations of various sorts. The US also will have to be ready to provide international inspectors with access to Defense Department and industry facilities. With 6,000 to 10,000 US facilities likely to be affected by the treaty, a call has been made for streamlining the regulatory scheme the US sets up to meet its treaty obligations. Preventing regulatory overlap would ensure that costs don't escalate, treaty effectiveness is not eroded, and greater risks to society are not created. The treaty is no more than a glorified international regulatory approach. It will take five to 10 years for the complicated regulatory mechanism to be reduced to reality. One must not be dismayed unnecessarily because of mistakes that will be made.

80 Senators appear skeptical of ABM treaty modifications. Lockwood, D. *Arms Control Today (United States);* 24(3): 17 (Apr 1994).

At a March 10 Senate Foreign Relations Committee hearing, several senators questioned the wisdom of the Clinton administration's proposal to try to "clarify" a key provision in the Anti-Ballistic Missile (ABM) Treaty that would permit the development and deployment of highly capable theater ballistic missile interceptors. The senators stressed that the executive branch should not try to change the pact in this manner without Senate approval. In response to questions, Arms Control and Disarmament Agency (ACDA) Director John Holum said without the proposed changes, the United States may not test new anti-tactical ballistic missile (ATBM) defense systems currently under development.

81 Denuclearization of South Africa: epiphenomenon or model. Duval, M. *Defense Nationale Problemes Politiques Scientifiques Militaires (France);* 50(4): 111-121 (Apr 1994). (In French).

Steps of South Africa denuclearization policy are presented with some examples of other official or unofficial nuclear nations. (A.B.).

82 Managing excess weapons plutonium. Keeny, S.M. Jr. *Arms Control Today (United States);* 24(2): 2 (Mar 1994).

The United States and Russia have pledged to reduce their nuclear forces by some 80 percent by the early years of the next century. Unfortunately, no comparable commitment exists to deal with the resulting excess warheads or the 100 to 200 tons of plutonium and several times as much highly enriched uranium which would be released by the dismantlement of these warheads. This fissile material, enough for several tens of thousands of warheads, would constitute a major threat to international security in the event of either a breakout from existing commitments or diversion to unstable or terrorist states.

83 **Latin America's emerging non-proliferation consensus.** Redick, J.R. *Arms Control Today (United States);* 24(2): 3-9 (Mar 1994).

Latin America's incorporation into the international nuclear non-proliferation regime is well advanced. The 1967 Tlatelolco Treaty, which established a regional nuclear-weapon-free zone (NWFZ), is nearing completion. A signal event occurred January 18, when Argentina and Chile deposited instruments of ratification to the treaty, leaving Brazil and Cuba the only major countries in Latin America that are not yet contracting parties. And after more than two decades of concern about the nuclear programs and policies in Argentina and Brazil, there is room for great optimism that Brazil may now be moving quickly on important non-proliferation issues. Even Cuba, the "bad boy of the neighborhood" in the eyes of many, which held aloof from the Tlatelolco process for three decades, has stated its willingness to join the zone in the future.

84 **Closing the nuclear umbrella.** Carpenter, T.G. (Cato Institute, Washington, DC (United States)). *Foreign Affairs (United States);* 73(2): 8-13 (Mar-Apr 1994).

It is time for US leaders to reassess Cold War policies on nonproliferation, security commitments and extended deterrence and to adapt them to changed international circumstances. These commitments may once have made sense, given the need to thwart the Soviet Union's expansionist agenda. But they are highly dubious in the absence of the superpower rivalry. They now threaten to embroil the United States in regional conflicts where nuclear weapons have already proliferated or will inevitably proliferate soon. Washington should give up its fruitless obsession with preserving the NPT and the unraveling nonproliferation system that it represents.

85 **Current prospects for a comprehensive nuclear test-ban treaty.** Tanaka, Y. *Disarmament (UN);* 16(3): 9-13 (Mar 1994).

The history of negotiations on nuclear test ban and current prospects for comprehensive test ban treaty are described.

86 **Purchasing power.** Lockwood, D. (Arms Control Association, Washington, DC (United States)). *Bulletin of the Atomic Scientists (United States);* 50(2): 10-12 (Mar-Apr 1994).

The present article describes several treaties which have been signed at the Moscow summit in January for reducing nuclear risks. The article separately discusses agreements and their implications for Russia, Belarus, Ukraine, and Kazakhstan. The focus of the discussion is on the Nunn-Lugar assistance program, which was initiated in 1991 to help the former Soviet Union denuclearize and demilitarize. The stance of the Clinton administration as compared to that of the Bush administration toward formulating and implementing assistance projects and also the expenditures involved in such assistance programs are addressed.

87 **Denuclearization in Argentina and Brazil.** Goldemberg, J.; Feiveson, H.A. *Arms Control Today (United States);* 24(2): 10-14 (Mar 1994).

The political process that led to the important agreements reached between Argentina and Brazil to guarantee that nuclear energy is used in both countries exclusively for peaceful purposes could prove to be a useful model. These achievements are due primarily to the return of democratic rule in both countries. While the political processes leading to fully integrated democratic institutions may not have taken hold as fully in other regions of proliferation concern, the Argentine-Brazilian agreements suggest that similar regional safeguards arrangements might be possible in South Asia, on the Korean Peninsula eventually, and perhaps in portions of the Middle East. These agreements include the creation of the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) for the application of safeguards to both countries; and the Quadripartite Agreement between Brazil, Argentina, the International Atomic Energy Agency (IAEA) and ABACC.

88 **Current efforts to negotiate a nuclear test-ban.** Norberg, L. *Disarmament (UN);* 16(3): 14-18 (Mar 1994).

The author discusses current efforts of the parties concerned in completion of the comprehensive test ban treaty and its effect on non-proliferation regime.

89 **The only credible deterrent.** Cropsey, S. *Foreign Affairs (United States);* 73(2): 14-20 (Mar-Apr 1994).

The success of even an economic cripple like North Korea in building nuclear weapons demonstrates that the Clinton administration's nonproliferation policy is doomed. The policy ignores the obvious: The spread of nuclear weapons and the means to deliver them has already advanced so far that the important question is no longer how to stop their proliferation, but rather how to prevent them from being used. Three options exist for the United States in dealing with emerging nuclear states: To persist in its current policy, which uncertainly presumes that America will extend its nuclear arsenal to regional allies and retaliate in kind against any nuclear attack; to withdraw its nuclear protection and ignore the dangers of regional nuclear conflicts as being of limited strategic interest; or to try to deter a regional nuclear aggressor through America's new conventional weapon technologies. Only the third option offers a credible strategy that adheres to American interests. Since the end of the Cold War, the idea that the United States will use nuclear weapons to defend allies in peripheral regions has lost credibility and cannot protect either the United States or its allies from attacks by rogue states. Yet this is a danger, and a responsibility, that the United States cannot shun. As long as it remains the world's greatest economic and military power, America will be a prime target of ambitious tyrants with malignant designs.

90 **Central America and Cuba in the new world order.** Smith, W.; Gilbert, L. *Arms Control Today (United States);* 24(2): 15-20 (Mar 1994).

In Central America and the Caribbean, as in many other parts of the world, military institutions are being forced to define new roles for themselves in the post-Cold War era. In recent times, developments throughout the region, including the dismantling of Panama's military, the downsizing of the armed forces in El Salvador and Nicaragua, a call by the new Honduran president for military reform and renewed peace talks in Guatemala, suggest that the time may be ripe to reinvigorate earlier regional political organizations and to press for a new round of talks to achieve regional arms control. During the 1980s, the ideological struggle between East and West, reignited by the Nicaraguan revolution in 1979, dragged the entire region into conflicts that devastated the isthmus in terms of human lives and economic infrastructure. Indigenous struggles that had developed during the

1970s were suddenly thrust upon the international stage, becoming part of a larger drama between the superpowers. Conflicts in El Salvador, Nicaragua and Guatemala provided impetus for larger armed forces throughout the region. This growth was justified as necessary to defend the state from external intervention and the established order from internal subversion, goals which were seen as complementary.

91 Chemical weapons treaty ratification races clock in Congressional hearings. Ember, L.R. *Chemical and Engineering News (United States);* 72(12): 16-17 (21 Mar 1994).

The pounding of the gavel in the Senate Foreign Relations Committee hearing room on Tuesday served as the starting gun signaling the beginning of the Senate's race toward a July finish line: US ratification of the chemical weapons treaty. President Clinton sent the treaty to Congress for Senate consent to ratification and for House and Senate approval of implementing legislation soon after the US signed it on Jan. 13. But the crush of other Congressional business–domestic legislation and other arms control agreements–has, in the words of one Congressional staffer, kept this accord "off the members' radar screens." That is, until this week, when the Senate Foreign Relations Committee held its first in a series of hearings on the Chemical Weapons Convention (CWC). At the hearing, top officials from the State Department and the Arms Control & Disarmament Agency offered an overview of the treaty and US obligations under it. After the committees get past a general understanding of the accord's requirements, they will begin probing for problems. Issues likely to be explored include the treaty's verifiability; its effect on industry, and especially whether confidential business information can be protected; the US's ability to meet the accord's chemical weapons destruction schedule; and Russia's ability to destroy its chemical stocks. Costs that the US will bear to support the international organization now being set up to implement and monitor the treaty, and financial aid to the Russians for destruction of their chemical arms, also will be scrutinized.

92 Delivering test-ban results by 1995. Hernandez, S. *Disarmament (UN);* 16(3): 19-34 (Mar 1994).

The article discusses issues of negotiations on comprehensive test ban treaty with respect to forthcoming 1995 non-proliferation treaty conference.

93 Prospects for Ukrainian denuclearization after the Moscow trilateral statement. *Arms Control Today (United States);* 24(2): 21-26 (Mar 1994).

On January 14, at the Moscow summit, Presidents Bill Clinton, Boris Yeltsin of Russia and Leonid Kravchuk of Ukraine issued a trilateral statement that again commits Ukraine to denuclearize in compliance with START I and the Lisbon Protocol and to join the nuclear Non-Proliferation Treaty (NPT) as a non-nuclear-weapon state. Recognizing that scant media attention had been paid to the importance of the trilateral statement, the Arms Control Association (ACA) held a news conference on January 28 to provide background and context on the many issues that affect prospects for Ukrainian denuclearization.

94 Management and disposition of excess weapons plutonium: Excerpts from the executive summary of the National Academy of Sciences report. *Arms Control Today (United States);* 24(2): 27-31 (Mar 1994).

On January 24, 1994, the National Academy of Sciences released a major policy report recommending a comprehensive approach to the handling of the large stocks of weapons plutonium no longer needed with the end of the Cold War. The study, entitled "Management and Disposition of Excess Weapons Plutonium," presents detailed recommendations on a reciprocal US-Russian plutonium regime, which would include: declarations on total inventories of weapons and fissile materials, monitored dismantlement of weapons, safeguarded interim storage of materials, and long-term disposal of excess plutonium either by vitrification into large logs with high-level waste or by use as fuel in existing reactors without future reprocessing.

95 Approaching a comprehensive test ban; a United States historical perspective. Seaborg, G.T.; Loeb, B.S. *Disarmament (UN);* 16(3): 35-55 (Mar 1994).

The historical aspects of negotiations on comprehensive nuclear weapons test ban and US attitude to the problem at present time are outlined.

96 The Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean. *Arms Control Today (United States);* 24(2): 42-44 (Mar 1994).

The Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean, known as the Treaty of Tlatelolco, seeks to establish a nuclear-weapon-free zone (NWFZ) that will extend from the US-Mexican border to Antarctica's territorial boundaries, including large areas of open ocean. Under the treaty, signatory states pledge not to test, use, produce, manufacture or acquire nuclear weapons; to use nuclear materials and facilities "exclusively for peaceful purposes;" and not to permit the stationing or development of nuclear weapons on their territories.

97 Uranium: Weapons conversion looms. Pool, T.C. *Engineering and Mining Journal (United States);* 195(3): 55-58 (Mar 1994).

Just when the uranium industry could begin to draw some comfort from a rapidly expanding gap between consumption and production, the possibility of huge supplies from the conversion of nuclear weapons has moved from an abstract concept to a near-term probability. The flow of material has yet to begin, but perceptions of the ready availability of fuel from converted weapons held prices and production at low levels during 1993. World uranium production declined to 87.5M lb U_3O_8 down about 6% from 1992. Consumption increased slightly to 149.2M lb. It seems unlikely that any other major commodity would experience, or could support, such an imbalance. However, in every year from the inception of the nuclear era in 1939 through 1990, uranium production exceeded consumption. This excess accrued as substantial inventories in both the military and civilian sectors. Since 1990, consumption exceeded production, and the deficiency has been filled by a drawdown of civilian inventories. Military inventories are just beginning to enter the marketplace but are expected to make an increasing contribution to the supply picture in as few as three or four years. In 1993, market restrictions on uranium from the newly independent states (NIS) of the former Soviet Union continued to impact imports into both the United States and the European Community (EC). As a result, a two-tiered pricing system remained in effect with prices for NIS material averaging about $7/lb U_3O_8, while uranium of other origins sold for about $10/lb. Negotiations continued on several fronts

throughout the year to rationalize the participation of the NIS in the world market. In a major break-through at year end, the U.S. Department of Commerce (DOC) announced tentative agreement on a plan which would tie Russian imports into the United States to new U.S. production on a pound-for-pound basis. Such a plan would be a boost to both United States and Russian producers.

98 **Regional security and nuclear non-proliferation.** Elaraby, N. *Disarmament (UN);* 16(3): 57-65 (Mar 1994).

This article discusses some of the issues related to to the finalization and the implementation of the draft African nuclear-weapon-free-zone treaty.

99 **A nuclear-weapon-free zone in the Middle East and effective verification.** Freier, S. (Weizmann Inst. of Science, Rehovoth (Israel)). *Disarmament (UN);* 16(3): 66-91 (Mar 1994).

The issues of creating a nuclear-weapon-free-zone in the Middle East and effective verification are discussed as well as thr related Israel's policy positions.

100 **A nuclear-weapon-free zone in Africa.** Sy, I. (United Nations, New York, NY (United States). Organization of African Unity). *Disarmament (UN);* 16(3): 92-102 (Mar 1994).

The former and present activities of the Organization of African Unity in creating a nuclear-weapon-free-zone in Africa are described.

101 **What future for the treaty on nuclear weapons non-proliferation.** Duval, M. *Defense Nationale Problemes Politiques Scientifiques Militaires (France);* 50(2): 83-100 (Feb 1994). (In French).

The Non-Proliferation Treaty, concluded for 25 years, will end in 1995. An analysis of the non-proliferation, of the treaty, of the concerns of nuclear and non nuclear countries, and of the future prospects specially for France is presented. (A.B.).

102 **Nuclear test ban monitoring: New requirements, new resources.** van der Vink, G.E.; Park, J. *Science (Washington, D.C.) (United States);* 263(5147): 634-635 (4 Feb 1994).

The authors of this article make the case for using open seismic networks in the monitoring of nuclear explosions for compliance with a global Comprehensive Test Ban Treaty (CTBT). These stations could be integrated with global communications networks to reduce the cost of monitoring for a CTBT. They would be multiuse stations not only for monitoring explosions but also for recording earthquake activity, assessment of seismic risk, and exploration of the earth's interior. Such networks now exist, but political aspects of negotiations for a CTBT have prevented them from being incorporated into the verification effort.

103 **Will political realism prevail in Kiev?.** Keeny, S.M. Jr. *Arms Control Today (United States);* 24(1): 2 (Jan-Feb 1994).

The Moscow summit produced a major step toward resolving the impasse on Ukrainian denuclearization, the world's most serious nuclear proliferation problem. The trilateral statement signed by Presidents Clinton, Yeltsin and Kravchuk calls for delivery to Russia for dismantlement of some 1,800 Ukrainian strategic warheads, reportly over a period of less than three years. The document was described as a political declaration and not an agreement. It does not guarantee that the total denuclerization of Ukraine will occur on schedule. But it does establish an ongoing process to accomplish that end on a compensated basis, which should encourage formal Ukrainian ratification of START I and adherence to the nuclear Non-Proliferation Treaty (NPT).

104 **The ACDA agenda in the post-cold war world.** Holum, J.D. *Arms Control Today (United States);* 24(1): 3-6 (Jan-Feb 1994).

The Arms Control and Disarmanent Agency (ACDA) now has the political support and institutional structure it needs to perform its post-Cold War mission. ACDA's central mission will be to consistently and forcefully put forward its unique perspective. Arms control and defense are both vital elements of the same national purpose, to support the national security of the United States (U.S.) The ACDA's efforts include extenting the Non-Proliferation Treaty, pursuit of a comprehensive Test Ban Treaty, committment to strengthen multilateral export controls, and ensure that the International Atomic Energy Agency (IAEA) has sufficient resources to implement its vital safeguards responsibility.

105 **The 103rd Congress and Arms Control.** Isaacs, J. *Arms Control Today (United States);* 24(1): 7-10 (Jan-Feb 1994).

The 103rd Congress, heavily Democratic as usual, faced the unusual situation of a Democratic in the White House setting the national security agenda. Congressional Democrats spent 12 years battling the Reagan and Bush administrations on the pace of arms control negotiations, treaty interpretation, military budgets and strategic weapon issues. Congressional Republicans, on the other hand, had grown comfortable deferring to and defending the executive branch's execution of arms control and foreign policies. Congressional democrats opted to attempt to influence ongoing executive branch security policy deliberations rather than to try to overturn decisions already announced.

106 **Disarmament in a changing world: Opportunities, trends and perspectives.** Boutros Ghali, B. *Disarmament (UN);* 17(2): 1-9 (1994).

In his opening address the Secretary-General stressed the necessity of further efforts directed to strengthening non-proliferation regime and an important role of IAEA with this regard. 4 notes.

107 **The centrality of the bomb.** Alperovitz, G.; Bird, K. *Foreign Policy (United States);* (94): 3-20 (Spr 1994).

This paper examines the role of atomic weapons in the Cold War. Examined are: the history of the development of the bomb; the policies it made possible, such as German reconstruction; the relationship that developed between the U.S. and the Soviet Union; and what would have happened without an early U.S. momopoly in atomic weapons.

108 **Phase out the bomb.** Blechman, B.M.; Fisher, C.S. *Foreign Policy (United States);* (97): 79-96 (Win 1994).

The authors premise is that technology diffusion and economic interdependence are creating a modernistic world in which a growing number of states share important common interests, values, and perspectives. These common interests can ultimately provide a basis for cooperation to control and eliminate weapons of mass destruction. Republican and

Democratic administrations have long recognized that the widespread dissemination of weapons of mass destruction would pose unacceptable risk to the U.S. security. Yet U.S. policy has only been able to slow proliferation, not end it. More gradually than anticipated, but inexorably, more countries have gained capabilities to manufacture weapons of mass destruction, along with the missile systems to deliver them rapidly. If the current trends continue, new countries seem likely to join the nuclear club in mid-term, and even more countries after that. A radically different approach is required if the U.S. is serious about stopping the spread of nuclear capabilities. The U.S. seeks to convince would-be proliferators that nuclear weapons are neither a legitimate nor an effective means of protecting national security, yet U.S. foreign and defense policies telegraph exactly the opposite message. An agenda for eventual elimination of Nuclear, Chemical and Biological weapons is given.

109 **Eurasia letter: Unneighborly neighbors.** Kincade, W.H.; Melnyczuk, N. *Foreign Policy (United States);* (94): 84-104 (Spr 1994).

Russo-Ukrainian relations are in a state of crisis. In the foreseeable future, they will probably take one of three possible courses: collective security in the Commonwealth of Independent States (CIS) or another security regime, cold war, or open conflict. To avoid the latter outcome, presidents Boris Yeltsin of Russia and Leonid Kravchuk of Ukraine must go further than they have to date in implementing past agreements and quelling nationalist passions in their countries. Russia's fear about the implications of losing its protective empire and Ukraine's strategic fears about national survival, though not groundless, could prove self-fulfilling if unreasonably exaggerated. The most salient security issues in dispute are the disposition of nuclear weapons, the former Soviet Black Sea Fleet, and the Crimea. Whatever course is taken, American leadership is crucial. Unlike other cold wars - incipient or actual - the Ukrainian-Russian case involves a third party (the United States) well placed to influence the relations of the antagonists because it shares their interests. The United States seems to have finally recognized that it is not dealing separately with Russia and Ukraine but rather with their relationship. Likewise, Ukraine and Russia need to understand that they cannot gain their desiderata from the United States or the West without expressing their differences in a more sensible way, while pursuing a clear, steady, and stabilizing reform track. The United States has a vital interest in a generally peaceful and stable international order. In a world that is heavily armed, still nuclearized, and rife with discontent, that stake has not diminished. The United States can change its leadership role but not relinquish it. A cold war between Russia and Ukraine, especially if it deteriorates into a hot one, would be a tragedy for those two countries and disastrous for American interests.

110 **"Lure" North Korea.** Park, M.Y.M. *Foreign Policy (United States);* (97): 97-105 (Win 1994).

The author discusses the frustrations of the international community in dealing with North Korea after negotiation of the Nuclear Non-proliferation treaty. In the past, the international community has not been well prepared to deal with the North Korean obstinacy. It has repeatedly misjudged North Korean goals, South Korean Interests, and Japanese reactions. A new approach is proposed for the long run, that avoids coercion or appeasement. Economic incentives are suggested as the means to bring about changes in North Korean attitudes that will ultimately foster the desire for maintaining economic stability and well being rather than warlike independence. China and the former Soviet Union are not considered supportive of a warlike posture in North Korean but are making economic overtures to South Korea themselves. If the economic approach proves successful, it will enhance the chances of Korean unification by peaceful means and under democratic rule because time is on the side of democracy. In the long run nonproliferation will be achieved through unification.

3502 Proliferation

Refer also to citation(s) 5, 9, 21, 22, 25, 26, 30, 31, 37, 39, 40, 41, 42, 43, 44, 45, 46, 51. 58, 59, 64, 65, 66, 77, 78, 81, 83, 84, 87, 88, 89, 92, 98, 101, 106, 108, 110, 156, 161

111 **Nuclear weapons databook. Volume V: British, French, and Chinese nuclear weapons.** Norris, R.S.; Burrows, A.S.; Fieldhouse, R.W. 437p. Westview Press, Boulder, CO (United States) (1994).

From review by Chuck Hansen, in Bulletin of the Atomic Scientists, Vol. 50, No. 4 (Jul-Aug 1994).

How insecurity and the search military independence drove post World War II nuclear proliferation beyond the United States and the Soviet Union is the subject of the latest and most voluminous title in the Natural Resources Defense Council's highly acclaimed Nuclear Weapons Databook series. Volume 5 explains how atomic and thermonuclear weapons spread to Britain, France, and China despite the political turmoil and economic hardship that beset these countries. The history of the British nuclear weapons program includes the most comprehensive collection of photos and specifications of British warheads and nuclear tests ever assembled in one publication. The role of the United States in the French nuclear weapons program is discussed. This is a comprehensive source for the mechanics and politics of nuclear weapons proliferation.

112 **Nuclear weapons proliferation and the new world order: New risks and possibilities of control.** (Kernwaffenverbreitung und internationaler Systemwandel: Neue Risiken und Gestaltungsmoeglichkeiten). Internationale Politik und Sicherheit, v. 36. Krause, J. (ed.) (Stiftung Wissenschaft und Politik/Forschungsinstitut fuer Internationale Politik und Sicherheit, Ebenhausen (Germany)). 540p. Nomos Verlagsges, Baden-Baden (Germany) (1994). (In German).

The proliferation of nuclear weapons has become the priority safety problem since the end of the cold war. The danger that new nuclear states may arise from the former Soviet Union, the limited effectiveness of existing control systems, the increased attractiveness of nuclear weapons for countries in which a 'safety vacuum' has developed since the withdrawal of American and Russian forces, as well as the danger that additional nuclear states (China, India, Pakistan) may become unstable or disintegrate, make it necessary to explore and show the ensuing risks. The study contains analyses from well-respected experts from Germany, Russia, Japan and the USA. They show how the changes in regional security situations could lead to nuclear risks under certain circumstances, and the likely international

consequences. A second point of emphasis consens the feasibility of new approaches or instruments in international non-proliferatic policy. New possibilities for the improvement of excisting control systems and the extension of international consensus on an intensification of the non-proliferation regime are offered by the changes in world politics. (orig.)

113 **Safeguards to build international confidence.** Harry, R.J.S. (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)). pp. 709-718 of International nuclear safeguards 1994: Vision for the future. V.2. Proceedings of a symposium held in Vienna, 14-18 March 1994. IAEA, Vienna (Austria) (Dec 1994). pp. 921 (CONF-940307–: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994; STI/PUB–945.).

Confidence of States in the exclusively peaceful use of nuclear activities is based upon systems of international safeguards. The declarations of States regarding their nuclear material and activities are subject to independent evaluation and inspection with the aim of checking whether the agreed criteria have been met. The performance of safeguards inspectorates of international organizations is subject to approval of Member States; also, information on safeguards systems is made available to the general public. The paper analyses the way in which safeguards support international confidence in non-proliferation of nuclear weapons. Also reviewed are the original paradigms of safeguards, the present situation, and the challenges and possible improvements for the future. Furthermore, certain problems are discussed, in connection with assurance of the completeness and correctness of declarations regarding nuclear material and activities, or the avoidance of questionable situations and the way of dealing with such situations; these are problems which have not yet been completely resolved. (author). 26 refs.

114 **Non-proliferation and disarmament: The task of verification.** pp. 1-8 of IAEA Yearbook 1994. IAEA, Vienna (Austria) (Sep 1994). pp. 320 (STI/PUB–955.).

This article outlines the IAEA's work and some of the recent developments in the safeguards area and discusses the potential for the verification capacity and experience of the IAEA to be used in connection with new international agreements.

115 **Status of preparations for safeguards implementation in Ukraine.** Glukhov, A. (Ukrainian State Committee on Nuclear and Radiation Safety, Kiev (Ukraine)); Steinberg, N. pp. 81-84 of International nuclear safeguards 1994: Vision for the future. V.1. Proceedings of a symposium held in Vienna, 14-18 March 1994. IAEA, Vienna (Austria) (Jul 1994). pp. 839 (CONF-940307–: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994; STI/PUB–945.).

At the 36th session of the IAEA General Conference, Ukraine was ready to put all the Ukrainian nuclear power plants (NPPs) and research reactors under IAEA control, and at the 37th session Ukraine declared its readiness to conclude a Safeguards Agreement with the IAEA and apply safeguards to all nuclear materials used for peaceful purposes under Ukrainian jurisdiction and control. However, from the political point of view the main problem is the nuclear weapons inherited by Ukraine from the former Soviet Union. According to the last agreement concluded between the Russian Federation, the United States of America and Ukraine, in January 1994, all the nuclear weapons in Ukraine will be shipped for dismantlement to the Russian Federation in exchange for nuclear fuel for Ukrainian NPPs. However, there is a problem as to whether the type of agreement to be concluded between Ukraine and the IAEA should be on the basis of INFCIRC/153 or INFCIRC/66. Independently of the political aspects the technical preparations have already commenced. The Ukrainian State Committee on Nuclear and Radiation Safety (UkrSCNRS) is officially responsible for implementation of domestic and international safeguards issues. The paper outlines the main areas of UkrSCNRS activity and discusses other regulations and agreements. (author). 2 refs, 1 tab.

116 **Assistance to newly independent states in establishing state systems of accounting and control of nuclear material.** Thorstensen, S. (International Atomic Energy Agency, Vienna (Austria). Dept. of Safeguards). pp. 95-102 of International nuclear safeguards 1994: Vision for the future. V.1. Proceedings of a symposium held in Vienna, 14-18 March 1994. IAEA, Vienna (Austria) (Jul 1994). pp. 839 (CONF-940307–: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994; STI/PUB–945.).

Nuclear trade and co-operation among States are essential dependent upon effective and credible safeguards. The disintegration of the former Soviet Union has resulted, inter alia, in the emergence of a number of newly independent States (NIS). With one exception, all the NIS have declared their intention either to become or to remain non-nuclear-weapon States, but many of them have nuclear programmes. However, the nuclear infrastructure on which those programmes once rested is no longer in place and needs to be reconstructed. The paper outlines work under way among the IAEA, its Member States and the NIS relating to the establishment and development in the NIS of State Systems of Accounting and Control (SSAC) of nuclear material. The paper describes IAEA activities in the NIS, including fact-finding missions and technical visits, the successful attempts to find donor States providing voluntary funding and expertise, and the co-ordination of technical support between the IAEA and the donor States. (author). 3 tabs.

117 **New dimensions in non-proliferation - an IAEA view.** Pellaud, B. (International Atomic Energy Agency, Vienna (Austria)). pp. 1-9 of 35th Annual meeting proceedings. Volume XXIII. Institute of Nuclear Materials Management, Northbrook, IL (United States) ([1994]). pp. 1360 (CONF-940748–: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994).

Four years ago, Saddam Husein invaded Kuwait with the intention of annexing it as Iraq's 19th state. The disclosure of the Iraqi nuclear weapons programme in the aftermath of the Gulf War - through the IAEA inspections - signalled the end of one proliferation era and the start of the next. In my remarks today, I have found it useful to identify four distinct proliferation eras, each with different features, each calling for different emphasis in international non-proliferation efforts. They provide a convenient way to look at the history of non-proliferation, to look into the future and to the new dimensions in non-proliferation that are slowly emerging.

118 **The future of the nuclear nonproliferation treaty.** Sands, A. (Lawrence Livermore National Lab., CA

(United States)). pp. 65 of The 160th national meeting of the American Association for the Advancement of Science: Science and a changing world. American Association for the Advancement of Science, Washington, DC (United States) (1994). pp. 240 (CONF-940257--: 160. national meeting of the American Association for the Advancement of Science (AAAS): science and a changing world, San Francisco, CA (United States), 18-23 Feb 1994).

This session will focus on the past, current, and future role of the Nonproliferation Treaty and its significance to nonproliferation efforts. Speakers will provide various perspectives on the Treaty's character and effectiveness, including those of signator and nonsignator states and weapon and nonweapon states. In addition, the discussion will address specific issues of technology transfer, sensitive technology leakage, security guarantees, safeguards, export controls, sanctions for violations, and weapon states' arms controls efforts. The session will also examine challenges to the NPT and the international regime, such as those presented by North Korea or the extension of the NPT. Participants will speculate on shocks to the nonproliferation regime, describing various unexpected trends or events, their significance, and their impacts. Some panelists may present controversial thoughts about the likelihood and impact of changes to the NPT, including the possibility of the NPT not being extended for any meaningful length of time or its significant modification. This session will provide a framework for understanding the run up to the NPT Review and Extension Conference in 1995. An encouraged throughout the presentations and ensuring open discussion as we grapple with what the options for dealing with the threat of nuclear proliferation are in the current transitional, but increasingly complex international and regional security environment.

119 **International plutonium management.** Nelson, R.D. (Arms Control and Disarmament Agency, Washington, DC (United States)). pp. 897-900 of 35th Annual meeting proceedings. Volume XXIII. Institute of Nuclear Materials Management, Northbrook, IL (United States) ([1994]). pp. 1360 (CONF-940748--: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994).

During the past two years there has been renewed interest in international management of plutonium. This is largely due to the surplus of plutonium from dismantled weapons and the accumulation of separated civilian plutonium--now slightly more than 100 metric tonnes and increasing at a rate of about 15 metric tonnes per year. A balance between the production and use of plutonium is not projected to occur until the year 2000 with a peak accumulation of about 150 metric tonnes. These growing stockpiles of separated plutonium pose a variety of proliferation risks. The issues that have arisen in international plutonium management discussions include limiting accumulated stocks of separated civil plutonium, monitoring excess weapons plutonium, transparency through confidence building measures, and the role of the IAEA. The U.S. has proposed, in addition to transparency, that there is a need to (1) balance supply and demand and (2) reduce and ultimately eliminate excess separated plutonium to have an effective IPM regime.

120 **Study of nuclear nonproliferation measures with a risk analysis approach.** Kano, Takashi (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). pp. 918-923 of 35th Annual meeting proceedings. Volume XXIII. Institute of Nuclear Materials Management, Northbrook, IL (United States) ([1994]). pp. 1360 (CONF-940748--: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994).

Policies for assuring the nonproliferation of nuclear weapons (hereinafter referred to as "nuclear proliferation") are actualized through a broad range of countermeasures. While concerned nations have actually implemented several of the various legal, institutional, technological and political countermeasures after long years of deliberation and striving for international consensus, differences of opinion still exist among nations, and debate continues. At the same time, with the end of the Cold War it is hoped that a comprehensive and effective nuclear nonproliferation structure capable of assuring broader support and understanding among the nations of the world will be established, and that the peaceful, stable use of nuclear energy under such a system is promoted. Therefore, this paper will comprehensively analyse the risk of nuclear weapons ever being used again; assess the basic characteristics of various risk factors and discuss the positioning of various nuclear nonproliferation measures to reduce these risk factors. The analytic methods presented herein are expected to become the basis of more detailed, extensive analysis and assessment.

121 **Taxonomy of potential international safeguards regimes.** Lemley, J.R. (Brookhaven National Lab., Upton, NY (United States)); Allentuck, J. pp. 1179-1183 of 35th Annual meeting proceedings. Volume XXIII. Institute of Nuclear Materials Management, Northbrook, IL (United States) ([1994]). pp. 1360 DOE Contract AC02-76CH00016. (CONF-940748--: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994).

Since the International Atomic Energy Agency's (IAEA) search for the components of Iraq's nuclear weapons program under the auspices of the United Nations Security Council, a consensus for enhancing, strengthening or expanding the scope of international safeguards has developed. Some of the enhanced safeguards concepts which have been suggested include the following: short-notice, challenge, and random inspections; effluent monitoring in on-site, near site, and fly-by modes; local and wide-area environmental monitoring; and utilization of data from space-platform sensors. Potential safeguards regimes can be classified according to the functional and technical criteria which would be necessary for implementation of various enhanced safeguards concepts. While the nature of the regime which will emerge cannot be predicted, the classification of possible regimes according to major characteristics can be useful for identifying functional criteria and implementation challenges, focusing development efforts on the functional criteria, and planning for efficient use of safeguards resources. Precedents established in previously negotiated treaties - the Chemical Weapons Convention, the Treaty on Conventional Forces in Europe, START, and Open Skies - are examined with regard to enhancement of the international safeguards regime for nuclear and other weapons of mass destruction. Bilateral, multilateral and regional integration of enhanced safeguards elements is considered.

122 **New dimensions in nonproliferation – An International Atomic Energy Agency view.** Pelland, B. (International Atomic Energy Agency, Vienna (Austria)). *JNMM (Journal of the Institute of Nuclear Materials Management) (United States);* 23(1): 24-28 (Oct 1994).

Four years ago, Saddam Hussein invaded Kuwait with the intention of annexing it as Iraq's 19th state. The disclosure of the Iraqi nuclear weapons program in the aftermath of the Gulf War–through the IAEA inspections–signaled the end of one proliferation era and the start of the next. In the author's remarks here, he has found it useful to identify four distinct proliferation eras, each with different features, each calling for different emphasis in international nonproliferation efforts. They provide a convenient way to look at the history of nonproliferation, and to look into the future and to the new dimensions in nonproliferation that are slowly emerging. Since the Gulf War, the nuclear world experienced a series of events of fundamental significance that changed the nature of nonproliferation, forcing changes in the mission of the IAEA and its methods. Certainly some of these events came in the form of unpleasant surprises, such as in Iraq, but very positive progress was also made on other fronts. He would like to share some perceptions of the events creating the present situation, and some views anticipating the requirements most likely to emerge in the coming years.

123 **Safeguards in transition: Status, challenges, and opportunities.** Pellaud, B. (International Atomic Energy Agency, Vienna (Austria). Dept. of Safeguards). *International Atomic Energy Agency Bulletin (Austria);* 36(3): 2-7 (Sep 1994).

Some thoughts and perspectives on the main challenges and opportunities facing IAEA safeguards, in the context of some recent developments and the overall evolution of the safeguards system are presented.

124 **Destruction of weapons-grade plutonium with pebble bed type HTGRs using burner balls and breeder balls.** Yamashita, Kiyonobu (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Tokuhara, Kazumi; Shindou, Ryuichi; Murata, Isao; Saikusa, Akio. *Nippon Genshiryoku Gakkai-Shi (Journal of the Atomic Energy Society of Japan) (Japan);* 36(9): 865-868 (Sep 1994). (In Japanese).

As the method of disposing the plutonium coming from disassembled weapons, the method of burning the fuel in which the plutonium is mixed with a parent material in LWRs or the disposal by glass solidification is proposed. In the former method, it is desirable to do the reprocessing of spent fuel for effectively utilizing fission products. The latter method needs watch against the diversion of the plutonium. The authors devised the method of effectively annihilating plutonium by separating into the burner balls of plutonium and the breeder balls of a parent material, and burning those by mixing in a pebble bed type high temperature gas-cooled reactor, while continuously exchanging them. It was clarified from the aspect of nuclear characteristics that by using this method, ^{239}Pu can be annihilated to the state of enabling the direct abandonment without reprocessing. The flow of burner balls and breeder balls in the reactor is shown, and multi-pass fuel exchange method was adopted to burn Pu in burner balls up. The rate of Pu annihilation was determined by the change of the amount of Pu for the burnup evaluated by lattice burning calculation. The maximum amount of Pu charge in one burner ball is limited by the maximum allowable power output of burner balls. (K.I.).

125 **Plutonium again (smuggling and movements).** *Energy Economist (United Kingdom);* (154): 2-7 (Aug 1994).

A link is discounted between nuclear proliferation and the recently discovered smuggled plutonium from the former Soviet Union at Munich airport and other places in Germany. It is argued that governments wishing to obtain nuclear materials to develop a weapons programme would not arrange to have it smuggled in a suitcase. Instead, it is speculated that a link exists between the plutonium smuggling incidents and the desire to promote the production of mixed oxide (MOX) fuel. Such incidents, by further raising public anxiety, may be intended to turn public opinion in favour of MOX fuel production as a sensible way of getting rid of surplus plutonium. (UK).

126 **New fuel for terror.** Nelan, B. *Time Australia (Australia);* (35): 25-29 (29 Aug 1994).

The first symptoms of the nuclear plague are spreading into Europe. After years of scares and false alarms, bomb-grade material on offer turned out to be fraudulent. German police have in the past four months uncovered four cases of smuggled nuclear material that could actually be used to make an atomic bombs. The former Soviet arsenal is leaking into the Est igniting fears of a new brand of nuclear horror. This article expose the facts and try to answer some of the obvious questions: who are the sellers? who are the buyers? and who can control it?. ills.

127 **A new fuel material for once-through weapons plutonium burning.** Akie, Hiroshi (Japan Atomic Energy Research Inst., Ibaraki (Japan)); Muromura, Tadasumi; Takano, Hideki; Matsuura, Shojiro. *Nuclear Technology (United States);* 107(2): 182-192 (Aug 1994).

For the burning of plutonium derived from nuclear warheads, once-through type oxide fuels have been studied by considering their proliferation resistance and environmental safety as well as their technological backgrounds of fuel fabrication and reactors. From phase relations of ceramic materials and their chemical properties, it seems that a two-phase mixture of a fluorite-type phase and alumina has favorable characteristics as a once-through-type fuel of plutonium burning. It also seems that the fluorite-type phases such as thoria and fully stabilized zirconia are acceptable as host phases of plutonium because of high solid solubility of the actinide elements and fission products, irradiation stability, and chemical stability. The spent fuels finally obtained will become mineral-like waste forms, which could be buried under deep geological formations without further processing. From reactor burnup calculations with the use of the fuels, light water reactors (LWRs) with the larger volume ratio of moderator to fuel than 1.4, such as conventional LWRs, are considered to be suitable for the once-through plutonium burning. Furthermore, such LWRs can transmute nearly 99% of ^{239}Pu and 85% of initial loaded weapons-grade plutonium. The quality of plutonium becomes completely poor in the spent fuels.

128 **US and Russia face urgent decisions on weapons plutonium.** Hileman, B. (C&EN, Washington, DC (United States)). *Chemical and Engineering News (United States);* 72(24): 12-25 (13 Jun 1994).

Surplus plutonium poses a "clear and present danger to national and international security," warns a National Academy of Sciences (NAS) study released in January, titled "The Management and Disposition of Excess Weapons Plutonium." Over the past few years, many different methods of disposing of plutonium have been proposed. They range from shooting it into the Sun with missiles, to deep-seabed disposal, to fissioning it within a new generation of nuclear reactors. The NAS report rejects most of the methods suggested so far, but does recommend pursuing two of the options. One is to incorporate the plutonium in mixed-oxide fuel, a mixture of plutonium and uranium oxides, and use it to fuel commercial nuclear reactors. The other is to mix the plutonium with high-level waste and molten glass and mold the resulting material into large glass logs for eventual geologic disposal. Both are discussed here. The panel that wrote the NAS study is a standing committee called the Committee on International Security & Arms Control. It suggests steps that should be taken now to guard supplies of plutonium removed from weapons. One step is bilateral US-Russian monitoring of warhead dismantlement. Others include setting up secure interim storage for the fissile materials and establishing an international monitoring system to verify the stockpiles and ensure that materials are not withdrawn for use in new weapons. The panel also urges Russia to stop producing fissile weapons materials and both countries to commit a very large fraction of their plutonium and highly enriched uranium from dismantled weapons to nonaggressive uses. The US and Russia have already made initial moves to accomplish these goals but have not fully implemented any of them.

129 **Statement to the 48th Session of the United Nations General Assembly.** Blix, H. (International Atomic Energy Agency, Vienna (Austria)). *Bezpecnost Jaderne Energie (Czech Republic);* 2(1-2): 30-34 (Jun 1994). Translated from IAEA/PI/C20E, 93-4857, IAEA Vienna, Nov. 1993. (In Czech).

A succinct account is given of IAEA activities in the fields of nuclear energy contribution to a sustainable development, of radioactive waste disposal, nuclear safety, nuclear disarmament and non-proliferation of nuclear weapons, and the safeguard system aimed at the Democratic People's Republic of Korea, South Africa, Iraq, Argentina, Brazil, Africa and the Middle East. Current IAEA initiatives concerning the international plutonium and HEU agreements, verified stopping of fission material production for military uses, agreement on a complete nuclear weapon testing ban, and preparation of the 1995 Nuclear Weapon Non-Proliferation Treaty Conference are also mentioned. (J.B.).

130 **An evaluation of the deployment of AIROX-recycled fuel in pressurized water reactors.** Jahshan, S.N. (EG&G Idaho, Idaho Falls, ID (United States). Idaho National Engineering Lab.); McGeehan, T.J. *Nuclear Technology (United States);* 106(3): 350-359 (Jun 1994). DOE Contract AC07-76ID01570.

An analytical evaluation is made of the pressurized water reactor (PWR) in-core performance of recycled light water reactor fuel that has been Atomics International reduction oxidation (AIROX) reprocessed and reenriched with fissile materials. The neutronics performance is shown to lie within the neutronics performance of existing high-performance and high-burnup fuels. Three AIROX-recycled fuels are compared with a high-burnup virgin fuel and an equivalent mixed-oxide (MOX) fuel. The AIROX-recycled fuel neutronics performance lies consistently between the virgin and the MOX fuel for both the pin power peaking and the reactivity response characteristics in PWRs. Among the attractive features of AIROX-recycled fuel is that it can optimize fissile and fertile fuel use, minimize final fuel disposal impact on the environment, and provide energy in the process of denaturing weapons-grade fissile materials. The fuel material performance may be anticipated from high-burnup virgin fuel and from MOX fuel performance. Recommendations for lead rod testing and for optimization of the AIROX-processing and resintering techniques are made.

131 **Stemming the tide of strategic weapons, part 1.** Foley, T. (Aerospace America, Washington, DC (United States)). *Aerospace America (United States);* 32(5): 6 (May 1994).

The need to monitor and control the proliferation of missiles and nuclear arms is creating a rare growth sector in the aerospace industry. Better means of inspection and intelligence are required. The article discusses new detection systems and the effects of the counterproliferation initiative.

132 **Skittish on counterproliferation.** Goldring, N.J. (British American Security Information Council, Washington, DC (United States)). *Bulletin of the Atomic Scientists (United States);* 50(2): 12-13 (Mar-Apr 1994).

This article outlines the United States proposal for a "counterproliferation" effort and the NATO response to the proposal. Official statements issued at the end of the January 1994 NATO summit in Brussels stressed unanimity, although serious differences in policy and process pervaded the summit. Ultimately, it appeared that NATO members are unwilling to participate–militarily or financially–in a U.S. plan to develop ballistic missile defenses against nuclear weapons. The author contends that the United States is sabotaging its policies on disarmament and proliferation by clinging to its nuclear and conventional weapon supremacy.

133 **Arming for peace.** Tsipis, K. (Massachusetts Institute of Technology, Cambridge, MA (United States)); Morrison, P. *Bulletin of the Atomic Scientists (United States);* 50(2): 38-43 (Mar-Apr 1994).

The present article discusses the prevention of wider proliferation of nuclear weapons beyond the Club of Five. Proliferation routes through weapons trade and through manufacture of weapons are compared for cost and effectiveness. Supply-side and demand-side efforts for nonproliferation are discussed. The causes for the demand for nuclear weapons are discussed. The authors outline an 11-step program which the United Stated can initiate and support for an effective demand-side nonproliferation policy parallel to its current supply-side efforts.

134 **Nuclear nonsense, black-market bombs, and fissile flim-flam.** Belyaninov, K. (Literaturnaya Gazeta, Moscow (Russian Federation)). *Bulletin of the Atomic Scientists (United States);* 50(2): 44-50 (Mar-Apr 1994).

This article describes the findings of three undercover Russian journalists who broke into the black market for nuclear materials. They relate their experiences of contacting brokers, describe the proposed deals, and reveal the results of some of the tests of samples. The economic pressures behind the black market are described. The dangers to the

participants of the black market and potential dangers to the public from uncontrolled trade in nuclear materials are discussed.

135 **Toward a nuclear-weapon-free world: a Chinese perspective.** Shen, D. (Fudan Univ., Shanghai (China)). *Bulletin of the Atomic Scientists (United States);* 50(2): 51-54 (Mar-Apr 1994).

In the present article, the author addresses China's policy on proliferation and nuclear testing. China, after observing an unannounced moratorium for more than a year, conducted a test last October, and maintains that it cannot exclude the need to carry out a few more tests for a certain period of time for national defense. The author discusses reasons for future tests. He suggests that a major factor in the testing may be to improve the safety and reliability of the present Chinese arsenal. He believes that whether or not China continues to test nuclear weapons will depend upon the balance of different national interests as perceived by the Chinese government. Following the underground test in Xinjiang province last October, the Chinese government issued a letter to U.N. Secretary-General Boutros Boutros-Ghali saying that it was entirely for the purpose of self-defense that China developed and possessed a small number of nuclear weapons, and that it had always exercised utmost restraint on nuclear testing. The letter also states that "after a comprehensive test ban treaty is concluded and comes into effect, China will abide by it and carry out no more nuclear tests." The author concludes that an international treaty banning nuclear weapons tests is important, but a no-first-use agreement would be just as useful. He discusses options for effecting a world-wide non-proliferation policy.

136 **Nuclear non-proliferation and the international inspection experience in Iraq.** Morel, B. (Carnegie-Mellon Univ., Pittsburgh, PA (United States)). *Disarmament (UN);* 16(3): 103-121 (Mar 1994).

Issues of nuclear non-proliferation and the international inspection experience in Iraq as well as lessons and consequences of iraq's nuclear programme are discussed.

137 **Sellafield and the bomb.** Roche, P. (Greenpeace, London (United Kingdom)). *Safe Energy (United Kingdom);* (99): 14-15 (Feb-Mar 1994).

One aspect of reprocessing, deliberately incorporated into the Non-Proliferation Treaty (NPT) is the right of Nuclear Weapon States (NWSs) to use civilian nuclear materials, including plutonium, in their weapons programmes. Evidence has slowly emerged over the past few years that the UK has diverted nuclear material, of UK and foreign origin, from civil to military programmes. The most immediate threat is the Thermal Oxide Reprocessing Plant (THORP). Unless its foreign customers have made special arrangements, the UK could use their plutonium in its nuclear weapons. This link between civil and military plutonium is examined. (author).

138 **A bomb waiting to explode.** Kiernan, V. *New Scientist (London) (United Kingdom);* 141(1914): 14-15 (26 Feb 1994).

With changing political relations between the United States and the former Soviet Block, the urgency of stockpiling uranium for weapons production has eased. However warheads continue to be discarded and civilian reactors continue to generate plutonium. As little as 5kg of plutonium is needed to make a bomb. This article looks at the political and security implications of stockpiling this dangerous chemical. (UK).

139 **Options for the limitation of undesirable access to plutonium.** Hardung, H. von (Tecop Group of Companies, Los Angeles, CA (United States)). *ATW, Atomwirtschaft, Atomtechnik (Germany);* 39(2): 142-145 (Feb 1994).

Under joint disarmament agreements, the United States of America and the states of the former Soviet Union are required to dismantle some 15,000 nuclear warheads, which implies the disposal of several hundred tons of weapon-grade unranium and a few tens of tons of plutonium. The military nuclear explosive can be used in the civilian nuclear fuel cycle for the peaceful use of nuclear power. At the present state of the art, and in view of the critical acceptance of advanced reactors, the use of military nuclear explosive is limited almost exclusively to the light water reactors currently in operation. (orig.)

140 **Nonproliferation boom gives a lift to the national labs.** Anderson, C. *Science (Washington, D.C.) (United States);* 263(5147): 627-629 (4 Feb 1994).

This article describes the research programs of the national laboratories in developing satellites for detection of nuclear weapons material production. The present designs detect thermal emissions from reactors and electromagnetic radiation from nuclear explosions. Future designs hope to detect the vegetation kill zones around waste holding tanks associated with uranium and plutonium processing.

141 **NAS outlines best options for plutonium disposal.** Lobsenz, G. *Energy Daily (United States);* 22(15): 1-2 (25 Jan 1994).

The best options for disposition of excess weapons-grade plutonium are fabrication into mixed-oxide fuel for use in existing reactors or vitrification with high-level radioactive waste, a National Academy of Sciences panel has concluded. The academy's Committee on International Security and Arms Control said a third option was burial in deep boreholes, although it said more research was needed to determine whether that solution would be "comparably attractive" to use of MOx fuel or vitrification. The panel said those three options represented the most feasible and cost-effective methods for the US and Russian governments to address security and proliferation concerns raised by their growing stockpiles of weapons-grade plutonium. It also urged the two governments to take immediate steps to pursue those options, saying indefinite storage of plutonium in weapons-usable form was clearly undesirable, especially in light of continuing instability in the former Soviet Union. More broadly, the panel called for bilateral US-Russian action to halt production of fissile materials, assure safe storage and devise international verification procedures to prevent resumption of weapons production and theft or diversion of nuclear bomb materials. Much of the panel's report was devoted to a detailed evaluation of the technical, political and economic advantages and disadvantages of various plutonium disposition methods, including such exotic schemes as dilution in the ocean, destruction through underground explosions and launches into space.

142 **North Korea and the "worst-case" scare-nario.** Albright, D. *Bulletin of the Atomic Scientists (United States);* 50(1): 3-6 (Jan-Feb 1994).

This article addresses the question of the quantity of plutonium held by North Korea. The amount of plutonium which could have been produced in its 5-mW electric, 20-30 mW thermal, gas-cooled, graphite moderated reactor at Yongbyon is discussed. An analysis of the CIA estimate of the supply of plutonium is provided. An estimation based on information supplied to the International Atomic Energy Agency (IAEA) by North Korea during IAEA inspections is performed. The implications of these estimates for the nuclear threat posed by North Korea are discussed.

143 Official announcement concerning the territorial applicability of the Nuclear Non-Proliferation Treaty: As of November 29, 1993. *Bundesgesetzblatt, Teil 2 (Germany);* (1): 16 (11 Jan 1994). (In German).

Short communication NON-PROLIFERATION TREATY/ enforcement; ENFORCEMENT; BELARUS; BELIZE; NUCLEAR WEAPONS

144 Spoils of peace: What to do with US warhead plutonium. Numark, N.J. (Numark Associates, Washington, DC (United States)); Suzuki, Tatsujiro. *Nuclear Engineering International (Incorporates Nuclear Power) (United Kingdom);* 39(474): 43-46 (Jan 1994).

The elimination of nuclear weapons presents the problem of what to do with the fissile material, particularly the Pu. For the US, where Pu recycling does not take place, two options appear most acceptable: burning Pu in a small number of dedicated LWRs using full-core MOX fuel; or vitrification and burial. (Author).

145 Russia's HEU sell-off: What cost to the West's nuclear industry?. Kovan, D. *Nuclear Engineering International (Incorporates Nuclear Power) (United Kingdom);* 39(474): 50-53 (Jan 1994).

The purchase of 500 tonnes of highly enriched uranium from Russian warheads is certainly a real peace dividend for the US, but it could be a major problem for the West's nuclear fuel industry. NUKEM has examined the options available for placing this material into the commercial market and its potential effect on the industry. NUKEM's findings are summarised. (Author).

146 IFR starts to burn up weapons-grade material. *Nuclear News (La Grange Park, Illinois) (United States);* 37(1): 66 (Jan 1994).

With funding from different parts of the federal government, the Integral Fast Reactor (IFR) project has survived into fiscal year 1994 and is now embarking on a demonstration of how this type of liquid-metal-cooled reactor (LMR) can be used to burn fuel derived from weapons-grade plutonium. This month, an assembly made from weapons-grade material is to be loaded into Experimental Breeder Reactor-II in Idaho, which is serving as the prototype for the IFR concept. Although FY 1994 work is being funded by the DOE, this particular examination of plutonium burnup is backed by the Department of Defense.

147 Disarmament: Still a primary task of the international community. Pfirter, R.F. *Disarmament (UN);* 17(2): 19-31 (1994).

In the context of global disarmament problems issues of nuclear disarmament and non-proliferation are discussed. 3 notes.

148 Disarmament after bipolarism: A programme for the 1990s. Morales Pedraza, J. *Disarmament (UN);* 17(2): 32-48 (1994). Translated from Spanish.

In the light of updating provisions of the 1978 Final Document of the first special session of the General Assembly devoted to disarmament issues of nuclear disarmament, prohibition of nuclear tests, prohibition of the production of fissionable material for nuclear weapons, nuclear-weapon-free zones, non-proliferation regime are discussed. 3 notes.

149 Moscow meltdown: Can Russia survive?. Stern, J.E. (Lawrence Livermore National Lab., CA (United States)). *International Security (United States);* 18(4): 40-65 (Spr 1994).

Western intelligence analysts and policy makers should pay closer attention to the centrifugal forces in Russia for two primary reasons: nuclear weapons are located in some of the most volatile regions, and central control of the armed forces is eroding. If Russia were to fragment, thousands of weapons and tons of fissile materials would be dispersed to new states with little safeguards infrastructure and little experience in controlling borders, a situation potentially far more dangerous than the breakup of the Soviet Union. Nuclear research, production, maintenance, and dismantlement facilities, plus uranium enrichment and plutonium separation facilities, could be inherited by new, unstable states. Further devolution of political authority could loosen control over sensitive exports and increase the risk of terrorist acquisition of fissile materials. This article discusses the confusion over the legitimacy of the physical and political boundaries of the Russian Federation; then, the economic incentives for regionalism in Russia; next, the main ethnic groups in Russia and the roots of ethnic nationalism in the Russian Federation. It then discusses political disarray in the center and in the regions, and the lack of unity among order-enforcing entities; focuses in somewhat more detail on the Volga-Ural region, where there is a concentration of nuclear weapons and facilities, and which is especially volatile politically. These factors taken together call into question Russia's viability as a state. In post-communist Russia, chaos has replaced order; license has replaced terror. Order-enforcing entities are eviscerated or in conflict. Neither economic shock therapy nor Group of Seven funds can help with these problems; Russia will not be a state until new unifying institutions are created, whether they are democratic or authoritarian.

150 The disposition of plutonium from dismantled warheads: a West European electric utility view. Goldschmidt, P.; Verbeek, P. *Nuclear Europe Worldscan;* 14(5-6): 49-54 (1994).

The civilian nuclear industry has a day-to-day experience of managing fissile materials and may help finding the best way to deal with plutonium from dismantled warheads. It is argued in this article that the experience that the European industry has gained in the management of reactor-grade plutonium can help the governments of Russia and the United States finding the best way to dispose of their excess weapons-grade plutonium. This article is based upon a paper given at the 27. annual conference of the Japan Industrial Forum in Hiroshima, Japan, April 13-15, 1994. (author) 5 figs., 1 tab., 24 refs.

151 Disarmament and security in a multipolar world: Non-proliferation, regional cooperation, keeping

and building the peace. La Gorce, F. de. *Disarmament (UN);* 17(2): 58-76 (1994). Translated from French.

In the context of disarmament process entering a new phase issues of consolidating the non-proliferation regime nuclear-weapon-free zones, export control regime of nuclear materials, and future of nuclear weapons are discussed. 8 notes.

152 The perils of proliferation: Organization theory, deterrence theory, and the spread of nuclear weapons. Sagan, S.D. (Stanford Univ., CA (United States)). *International Security (United States);* 18(4): 66-107 (Spr 1994).

What is missing in the literature on nuclear proliferation is an alternative theory of the consequences of nuclear proliferation; the effects of nuclear weapons on the likelihood of war. This article presents such an alternative, rooted in organizational theory, which leads to a more pessimistic assessment of the future prospects for peace. Professional military organizations display strong proclivities toward organizational behaviors that lead to deterrence failures. Such organizational proclivities can be effectively countered only by tight and sustained civilian control of the military. There are strong reasons to believe that future nuclear-armed states will lack such positive mechanisms of civilian control.

153 Highly enriched uranium production for South African Nuclear Weapons. Cochran, T.B. (Natural Resources Defense Council, Inc., Washington, DC (United States)). *Science and Global Security (United States);* 4(2): 161-176 (1994).

The authors estimate that South Africa produced 735 ± 53 kilograms of the equivalent of 90 percent-highly enriched uranium (HEU). This amount, were it enriched to 80 to 90 percent, could be used to construct 12 Hiroshima-type fission bombs. The South African government maintains it constructed only six such devices, and never intended to construct more than seven. The excess HEU was apparently less enriched than that desired by South Africa for its weapons, but probably still weapons-usable. Implosion-type devices were apparently being researched at the time the nuclear weapons program was dismantled in 1989. Had this effort continued, eventually South Africa would have been able to construct four times as many weapons from the same amount of fissile material. Because of a 15.6 percent uncertainty in the tails assay, the two standard deviation uncertainty in the amount of U-235 in the HEU produced is 256 kilograms. It is in the interest of all parties to reduce this uncertainty. 28 refs., 1 tab.

154 Weapons to fuel. Bukharin, O. (Princeton Univ., NJ (United States)). *Science and Global Security (United States);* 4(2): 179-188 (1994).

The economic implications of the U.S.-Russian HEU agreement remain uncertain, and will depend on the health of the uranium market and the performance of the U.S. gaseous diffusion enrichment plants. The agreement, however, could be essential for the dismantlement of nuclear weapons in Russia. It also provides an opportunity to develop security, economic and institutional arrangements that would be useful in dealing with fissile materials from weapons in the future. 7 refs.

3503 Verification and Control Technology

Refer also to citation(s) 6, 18, 99, 102, 113, 114, 116, 121, 123, 131, 140

155 Policy and technical issues for international safeguards in nuclear weapon states. Markin, J.T. (Los Alamos National Lab., Los Alamos, NM (United States). Safeguards Systems Group); Stanbro, W.D. pp. 639-652 of International nuclear safeguards 1994: Vision for the future. V.2. Proceedings of a symposium held in Vienna, 14-18 March 1994. IAEA, Vienna (Austria) (Dec 1994). pp. 921 (CONF-940307–: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994; STI/PUB–945.).

The application of international safeguards in nuclear weapon States (NWS) to verify declared excess fissile materials for weapons purposes and the cessation of production of fissile materials for weapons use would create policy and technical issues for the international inspectorate and the NWS. The paper examines options for resolving these issues, including modifications to the IAEA goals and safeguards approaches that would reduce inspection effort (with collateral reduction in inspection effectiveness), modifications in NWS classification laws to allow measurement of selected attributes of sensitive materials or to allow access to classified data by inspectors from selected NWS, offering weapons materials in an unclassified form to accommodate traditional IAEA safeguards, innovations in technology that would reduce the resource intensity of inspections, and innovations in technology that would allow verification of weapons materials and facilities while limiting disclosure of sensitive data. (author). 21 refs.

156 Verification of completeness and correctness of inventory. Experience gained in the verification of the completeness of the inventory of South Africa's nuclear installations and material. Dillon, G. (International Atomic Energy Agency, Vienna (Austria). Dept. of Safeguards); Pericos, G. pp. 231-241 of International nuclear safeguards 1994: Vision for the future. V.1. Proceedings of a symposium held in Vienna, 14-18 March 1994. IAEA, Vienna (Austria) (Jul 1994). pp. 839 (CONF-940307–: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994; STI/PUB–945.).

The activities carried out to verify the correctness of the inventory of nuclear material, included in the initial report, extended over several months and involved long established measures such as the examination of contemporary operating and accounting records, and destructive and non-destructive analysis of the nature and quantity of individual items and batches. The assessment of the completeness of the inventory of South Africa's nuclear installations and material was carried out as a separate exercise by a team of senior members of the IAEA Department of Safeguards specifically appointed for the purpose by the Director General. South Africa's extensive nuclear fuel cycle made the task of the assessment of completeness complex, requiring considerable inspection resources and extensive co-operation from the State authorities regarding the provision of access to defunct facilities and historical operating records. The task was further complicated when, on 24 March 1993, State President de Klerk announced, in broadcast speech to the Parliament, that South Africa had developed and subsequently dismantled a "limited nuclear

deterrent capability" involving the design and manufacture of seven gun-assembled (HEU) devices. An augmented IAEA team, composed of the personnel assigned to carry out the assessment of completeness, and, among other specialists, nuclear weapons experts were assigned to assess the status of the former weapons programme and to ascertain that all of the nuclear material involved in the programme had been recovered and had been placed under safeguards. 2 refs, 2 tabs.

157 Is the IAEA ready for additional verification responsibilities?. Ek, P.I. pp. 25-30 of 35th Annual meeting proceedings. Volume XXIII. Institute of Nuclear Materials Management, Northbrook, IL (United States) ([1994]). pp. 1360 (CONF-940748--: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994).

The International Atomic Energy Agency, IAEA, has traditionally been verifying what Member States have declared as their inventory of nuclear material. The Non-Proliferation Treaty Article III speaks about "safeguards...shall be applied on all source and special fissionable material in all peaceful nuclear activities..." and the NPT type Safeguards Agreements with the IAEA request the parties to accept safeguards on all nuclear material, in all peaceful nuclear activities, on its (the State's) territory or under its control anywhere. Thus, from legal point of view, it does not seem necessary for the IAEA to limit its verification activities to declared nuclear material only. This weakness of the system became very transparent when Iraq's clandestine programme became known. In order for the IAEA to retain its credibility, it has to add certain new activities to its safeguards system in order to repair this imperfection. At the same time there are ongoing discussions to add new tasks to the IAEA, including safeguarding nuclear material coming from dismantling of nuclear weapons, verifying a cut-off treaty, controlling the management of HEU and plutonium, and verifying compliance with a Comprehensive Test Ban Treaty. This paper will, in the light of 1995 NPT extension conference, discuss some questions regarding the continued credibility of the IAEA the consequences for the IAEA should it be asked to undertake additional verification responsibilities.

158 Design considerations for third party inspection activities for storage facilities. Zack, N.R. (Los Alamos National Lab., NM (United States)); Hunteman, W.J.; Jaeger, C.D.; Metzler, J.F. pp. 246-250 of 35th Annual meeting proceedings. Volume XXIII. Institute of Nuclear Materials Management, Northbrook, IL (United States) ([1994]). pp. 1360 (CONF-940748--: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994).

Initiatives by the President and the Secretary of Energy to make available national excess special nuclear materials for third party inspection and verification required special design requirements to be considered for the reconfigured weapons complex storage facilities. The approach that will be taken in the design and operation will permit controlled access to all nuclear materials and related information that would not disclose or lead to disclosure of classified or proprietary information not obligated by treaty or other agreements. This approach would provide the third party inspectors with the information and capability to access designated materials while minimizing impact upon facility operations. These considerations would also give the federal government the flexibility to add new materials to the excess materials category list in the future. This paper will discuss the safeguards and security design impacts and features that are being anticipated for the storage facilities, both for possible new construction and upgrading existing facilities.

159 Imaging targets embedded in a lossy half space with synthetic aperture radar. Doerry, A.W. (Sandia National Labs., Albuquerque, NM (United States)); Brock, B.C.; Boverie, B.; Cress, D. pp. 2508-2512 of IGARSS '94. Volumes 1, 2, 3 and 4. Institute of Electrical and Electronics Engineers, Inc., Pisacataway, NJ (United States) (1994). pp. 3116 DOE Contract AC04-94AL85000. (CONF-940814--: IGARSS '94: international geoscience and remote sensing symposium, Pasadena, CA (United States), 8-12 Aug 1994).

This paper addresses theoretical aspects of forming images from an airborne Synthetic Aperture Radar (SAR) of targets buried below the earth's surface. Soil is generally a lossy, dispersive medium, with wide ranging variability in these attributes depending on soil type, moisture content, and a host of other physical properties. Focussing a SAR subsurface image presents new dimensions of complexity relative to its surface-image counterpart, even when the soil's properties are known. This paper treats the soil as a lossy, dispersive half space, and presents a practical model for the radar echo-delay time to point scatterers within it. This model is then used to illustrate effects of refraction, dispersion, and attenuation on a SAR's phase histories, and the resulting image. Various data collection geometries and processing strategies are examined for both 2-Dimensional and 3-Dimensional SAR images. The conclusions from this work are that (1) focussing a SAR image must generally take into account both refraction and dispersion, (2) resolving targets at different depths in lossy soils requires perhaps unprecedented sidelobe attenuation, that for some soils may only be achievable with specialized window functions, (3) the impulse response of the soil itself places a practical limit on the usable bandwidth of the radar, and (4) dynamic ranges and sensitivities will need to be orders of magnitude greater than typical surface-imaging SARs, leading to significant impact on SAR parameters, for example compressing the usable range of pulse repetition frequencies (PRFs).

160 IAEA symposium on international safeguards: Mirror of the times. Wedekind, L.H. (International Atomic Energy Agency, Vienna (Austria). Div. of Public Information); Larrimore, J.A. *International Atomic Energy Agency Bulletin (Austria);* 36(3): 8-12 (Sep 1994).

During the week-long symposium at IAEA headquarters in March 1994, experts from 42 countries examined the issues of development of a reinforced nuclear verification system in response to new demands and rising expectations. In all, some 200 papers were presented at 20 sessions on safeguards technologies, monitoring systems, analytical methods, operational criteria and approaches, and other topics.

161 How much plutonium does North Korea have?. Albright, D. *Bulletin of the Atomic Scientists (United States);* 50(5): 46-53 (Sep-Oct 1994).

U.S. intelligence discovered in the 1980s that North Korea was building a small nuclear reactor. The reactor was described as a gas-cooled, graphite-moderated model similar

to those Britian and France used to produce electric power as well as plutonium for nuclear weapons. When Western nations expressed concern about the reactor Russia pressed North Korea to sign the Non-Proliferation Treaty (NPT) which it did on December 12, 1985. However, North Korea stalled on signing the required safeguards agreement that allows the International Atomic Energy Agency (IAEA) to inspect nuclear facilities until January 1992. Inspections by the IAEA revealed discrepancies with the amounts of plutonium separated as declared by the North Koreans. The IAEA also received reports that two North Korean waste sites were hidden. By February 1993 the IAEA and the North Koreans has reached an impasse: North Koreas initial declarations of plutonium inventory could not be confirmed and North Korea refused to cooperate. At the least, North Korea admits to having separated 100 grams of plutonium. At the most, worst case estimate, they could have a total of 6 - 13 kilograms of separated plutonium. A first nuclear weapon can require up to 10 kilograms of weapon-grade plutonium. Any settlement needs to include a way to insure that the IAEA can verify North Korea's past nuclear activities and determine the amount of plutonium that may have been separated in the past. 2 refs.

162 Gamma-ray spectroscopic systems for remote detection and monitoring of fissile materials. Baryshevsky, V.G. (Inst. for Nuclear Problems, Minsk (Belarus)); Khrutchinsky, A.A.; Moroz, V.I.; Dezhurko, M.D. *IEEE Transactions on Nuclear Science (Institute of Electrical and Electronics Engineers) (United States);* 41(4Pt1): 971-975 (Aug 1994). (CONF-931051–: NSS-MIC '93: nuclear science symposium and medical imaging conference, San Francisco, CA (United States), 30 Oct - 6 nov 1993).

The scientific and methodical aspects of system design for radiation monitoring of nuclear weapons for treaty verification and for customs monitoring to prevent contraband of the fissile materials are considered in this paper. The γ-ray spectroscopic systems for remote detection of nuclear weapons and for the monitoring of the number of warheads within a missile nose cone are considered, and the results of experimental test and computer simulations of this system are given.

163 Measurement of large ground motions with the ASM gage. Wright, B.L. (P15 MS D406, P15 MS D406, and M6 MS C970, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (United States)); Alrick, K.R.; Fritz, J.N. *AIP Conference Proceedings (American Institute of Physics) (United States);* 309(1): 1747-1750 (10 Jul 1994). (CONF-921145–: Production and neutralization of negative ions and beams, Upton, NY (United States), 9-13 Nov 1992).

Conversion of the energy from undergound explosions to distant seismic signals involves hydrodynamic flows sampling a wide range of pressures. For lower pressures a larger portion of the initial wave motion must be measured to obtain definitive results. The intermediate pressure range, where the initial wave is strong enough to destroy most instrumentation but does not contain definitive information in its initial amplitude, presents special difficulties. We present design considerations for an experiment implementing the ASM gage principle (induction of eddy currents in a moving conducting plate) that can sample wave motion for many milliseconds. In essence we hang a large metal plate (large in area) on a wall and watch the free-surface release. This is not an *in-itu* measurement of the wave profile because the incoming wave is modififed by the release propagating backward from the wall. However, this a relatively clean modification of the incoming wave and is a situation commonly handled in many shock-wave experiments. ©American Institute of Physics

164 Ongoing monitoring and verification in Iraq. Trevan, T. *Arms Control Today (United States);* 24(4): 11-15 (May 1994).

When Iraq informed the United Nations last November 26 that it would cooperate in implementing the plans to monitor compliance with its obligations not to reacquire weapons banned under the ceasefire agreements following the Gulf War, it signalled an apparent policy reversal after two years of difficulties, deadlocks and limited cooperation. While claiming never to have rejected the plans to implement nationwide monitoring and inspections to prevent the import or manufacture of nuclear, chemical and biological weapons and long-range ballistic missiles, Iraq consistently spoke of the plans in terms of political, if not legal, rejection.

165 Investigation of the ocean acoustic signatures from strong explosions at a long distance in the ocean sound channel by computer simulation. Kamegai, M. (Lawrence Livermore Natl. Lab., L-200, P.O. Box 808, Livermore, CA 94551 (United States)); White, J.W.; Clarke, D.B. *Journal of the Acoustical Society of America (United States);* 95(5): 2880 (May 1994). DOE Contract W-7405-ENG-48.

The identification and location of ocean acoustic signatures are the principal objectives of a program to discourage clandestine testing of nuclear explosives. Difficulties arise primarily from variations in the water column. In turn, these variations affect acoustic propagation in the SOFAR channel. In this study, the path effects on the signals generated by strong explosions (1 and 10 kn) are investigated. The goal is to make a quantitative correlation between the initial source description and the final acoustical signatures received at a great distance under various conditions. The study is performed entirely by computer simulations applying two computer programs in succession. First, the explosions are simulated by a 2-D hydrodynamic computer program, CALE, which was originally developed to calculate astrophysical problems. The computed signals have reached more than 700 m deep approaching the SOFAR channel. At this point, the CALE output is linked to a hydro-acoustic computer program, the NPE code, by which wave propagation in the SOFAR channel is modeled. The NPE code was developed at the Naval Research Laboratory to study ocean acoustics. [Work supported by the U. S. Department of Energy under Contract No. W-7405-ENG-48.]

166 Verification in a changing world. Lewis, P.M. *Disarmament (UN);* 17(2): 108-120 (1994).

The lessons of recently disclosed clandestine nuclear activities and prospects, with this respect and with respect of new realities, of further verification system development are discussed. 7 notes.

167 Weapons treaties: Chemical vs. nuclear. Keeley, J.F. (Univ. of Calgary, Alberta (Canada)). *Forum for Applied Research and Public Policy (United States);* 9(2): 122-125 (Sum 1994).

The organization that will monitor compliance with the chemical-weapons treaty will face many of the same problems that the International Atomic Energy Agency (IAEA) faces in monitoring the nuclear non-proliferation treaty, notes James J. Keeley of the University of Calgary in Alberta, Canada. While the nuclear and chemical industries are different, they share enough similarities so that IAEA can impart valuable lessons to the chemical verification agency, Keeley says. For example, internal budget and personnel restraints are apt to apply to both. On the technical side of the coin, similarities also can be found in the monitoring of certain strategic materials and in the strategies for on-site inspections. Above all, IAEA's experience "demonstrates that the inspection and verification of major industrial processes, while difficult, are not impossible," Keeley affirms.

Miscellaneous

168 (AD-A-277963/5/XAB) **Tagging RDTE. Volume 1. Technology assessment and development reports. Technical report.** Hill, B.J.; Dressel, E.M.; McCann, R.I.; Cabeen, R.E.; Wright, A. BDM International, Inc., Albuquerque, NM (United States). 1 Mar 1994. 398p. Contract DNA001-89-C-0189. (BDM/ABQ-93-0012-TR-VOL-1). Source: NTIS Prices: PC A17/MF A04.

See also Volume 2, AD-A277 964.

The purpose of the Tagging Research, Development, Test and Evaluation (RDTE) contract was to assist in the development of tag and seal systems to support U.S. arms control treaty verification inspections. Numerous technical assessments of tag and seal technology concepts were performed. Developmental. functional, operational, and environmental testing of DOE prototypes and commercial tag and seal systems representing a wide range of technologies were conducted. In addition, the Secure Loop Inspectable Tag/Seal (SLITS), the Passive Tamper Indicating Loop Seal (PTILS), and the Universal videographic Reader (UR) systems were developed to the industrial (fieldable) prototype stage. Arms control, Technology assessments, Treaty verification, Environmental testing, Tags and seals, Operational testing.

169 (AD-A-277964/3/XAB) **Tagging RDTE. Volume 2. Appendices A-G. Technical report, 15 September 1989-30 May 1993.** Alldredge, G.P.; Hill, B.J.; Dressel, E.M.; Corcoran, J.J.; Wright, A. BDM International, Inc., Albuquerque, NM (United States). 1 Mar 1994. 232p. Contract DNA001-89-C-0189. (BDM/ABQ-93-0012-TR-VOL-2). Source: NTIS Prices: PC A11/MF A03.

See also Volume 1, AD-A277 964.

Volume 2 - Appendices A-G contains comprehensive presentations of technical subjects considered too detailed for inclusion in the main body (Volume 1) of the Tagging RDTE Draft Final Report. The topics included are: Appendix A - Procedure for Annealing to Reduce Residual Stress in Injection-Molded Polycarbonate SLITS Joint Blocks Appendix B - PTILS Software Utilities Appendix C - SLOTS Optical Time Domain Reflectometry Measurements Appendix D - Analysis of the Limits of Splice Detectability in Plastic Optical Fiber Using the OFM20-OTDR Appendix E - Analysis of the Rayleigh Backscattered Power in a Multiwrap Glass SLOTS Optical Fiber with Bends and Splices Appendix F - Creative Task Final Report - Innovative Tags Appendix G - Utility Programs Used for Blink Comparator Process Optical Time Domain Reflectometry (OTDR), Passive Tamper Indicating Loop Seal (PTILS), Secure Loop Inspectable Tag/Seal (SLITS), Secure Loop Optical Tag/Seal (SLOTS).

170 (AD-A-278559/0/XAB) **Iran's strategic intentions and capabilities.** Clawson, P. National Defense Univ., Washington, DC (United States). Apr 1994. 132p. Source: NTIS Prices: PC A07/MF A02.

Iran appears to be pursuing an assertive foreign policy that confronts the United States on a variety of points: the Middle East Peace Process, the stability of moderate Muslim states, terrorism (such as the death threat to Rushdie), security in the Persian Gulf, and nuclear proliferation.

171 (AD-A-278837/0/XAB) **Hydroplus experimental study of dry, saturated, and frozen geological materials. Technical report, 15 July 1991-30 September 1992.** Gaffney, E.S.; Smith, E.A. Ktech Corp., Albuquerque, NM (United States). 1 Apr 1994. 129p. Contract DNA001-92-C-0057. (KTECH-TR-92-26). Source: NTIS Prices: PC A07/MF A02.

The dynamic shock responses of eight (8) types of rock and grouts were determined from one-dimensional plate impact experiments to support the Defense Nuclear Agency (DNA) HYDROPLUS program. Hugoniot data and loading and release paths were measured using in-situ stress gauges or VISAR interferometry. Two NTS tuffs from the DISTANT ZENITH and HUNTERS TROPHY test beds, a grout, MJ-2, which was designed to match the DISTANT ZENITH tuff and three carbonate rocks, Danby marble, Fort Knox carbonates and Salem limestone were characterized. All of these materials were tested in a water saturated condition at ambient and frozen conditions. Additionally, the Salem limestone was characterized dry. Hugoniot data for ice was also measured. Experiments that simulated jointed rock formation were conducted using Danby marble to evaluate the effects of water- or ice-filled joints on the amplitude of a stress wave propagating through the formation. Hugoniot data, release adiabats, and propagated waveshapes are presented for the rocks, grout, and ice. The effects of freezing, porosity, and dolomitization of the limestones on the Hugoniot and wave propagation characteristics of these materials are detailed. Propagated wave profiles and measured attenuation rates are given for the simulated jointed rock experiments. Hugoniot, DISTANT ZENITH Tuff, HUNTERS TROPHY Tuff, Release Adiabat, MJ-2 Grout, Danby Marble, Ice, Jointed Rocks, Fort Knox Carbonates.

172 (AD-A-279505/2/XAB) **From the sea: Chemical and biological concerns. Final report.** Murphy, J.M. Naval War Coll., Newport, RI (United States). Dept. of Operations. 8 Feb 1994. 31p. Source: NTIS Prices: PC A03/MF A01.

With the collapse of the Soviet Union the U.S. Navy devised a new strategy, ... FROM THE SEA. This strategy is designed to prepare the Navy for regional challenges. Proliferation of weapons of mass destruction is a major concern of U.S. national defense. This paper uses some historical examples and technological data to postulate conceivable effects from chemical and biological weapons on FROM THE SEA. The focus of this paper is on the operational level of war. The paper addresses what the Navy and the Unified Commander in Chiefs should do to prepare for operations in a contaminated environment. Chemical warfare, Chemical defense, From the sea, Joint Operations, Joint Maritime Operations, Chemical weapons, Biological weapons.

173 (AD-A-279513/6/XAB) **Impact on the PACOM regional command strategy of the evolving national security strategy. Final report.** Riddle, M.H. Naval War Coll., Newport, RI (United States). Dept. of Operations. 8 Feb 1994. 31p. Source: NTIS Prices: PC A03/MF A01.

This paper deals with the conclusions and recommendations of the impact the evolving United States national security strategy may have on the PACOM regional command strategy. The conclusions and recommendations are based on a survey of the January 1993 National Security Strategy of the United States presented by the outgoing Administration and the impact that the evolving strategy of the Clinton Administration is having. These conclusions and recommendations are also influenced by current events surrounding the activities and policy debate centered on the Peoples Democratic Republic of Korea. The conclusions drawn are that the objectives of national security are timeless and consistent from Administration to Administration, even when the party changes. The divergence occurs in emphasis and priority. Several impacts on the PACOM regional command strategy are identified as a result. To break the reliance on the strategy of deterrence requires refocusing of the priority from the global-international level to the regional level. The recommendation is made that the Administration should de-link the military considerations on the Korean peninsula from the international debate over the DPRK nuclear program.

174 (AD-A-279520/1/XAB) **Ballistic missile proliferation a national security focus for the 21st century. Research report.** Peterson, J.F. Army War Coll., Carlisle Barracks, PA (United States). 21 Apr 1994. 50p. Source: NTIS Prices: PC A03/MF A01.

The global proliferation of ballistic missiles and weapons of mass destruction (WMD) has become one of the most immediate and dangerous threats to U.S. national security. Ballistic missiles were used in four of the last six major wars. Some 190 missiles were fired by Iraqis over a six week period at Iranian cities in 1988, during the 'War of the Cities'. Iraq's firing of Scuds against coalition forces and Israel during the Gulf War provided a vivid reminder of the threat these weapons can present to the world community. During the 1980's, many Third World countries assigned a high priority to the acquisition of ballistic missiles. By 1991, more than 20 of these nations either possessed ballistic missiles or were attempting to obtain them. Today 43 nations possess ballistic missiles. Seventeen of these probably have a nuclear weapon capability, with 20 of them possessing also a chemical or biological capability. This paper seeks to: define the military challenge ballistic missiles represent; review current U.S. counter-proliferation and nonproliferation initiatives and, finally make recommendations on other potential methods or considerations to reduce ballistic missile proliferation.

175 (AD-A-279591/2/XAB) **CBW - are we prepared to combat the chemical/biological threat. Final report.** Kirkman, A. Naval War Coll., Newport, RI (United States). Dept. of Operations. 8 Feb 1994. 33p. Source: NTIS Prices: PC A03/MF A01.

This research paper analyzes the current chemical and biological threat faced by the United States from Third World Countries. It explores the impact this threat brings on military planning and execution and recommends avenues that the United States should take to hedge against it. A historical background of chemical and biological weapons use is presented with emphasis on the magnitude and extent of this problem. The legal and moral frameworks are examined with focus on the capabilities, limitations, intentions, and preparedness of the United States and Third World Countries. The thesis presented is that the United States' posture in combating chemical and biological weapons is severely compromised. A lack of governmental commitment, inadequate technologies, lack of success in arms control negotiations, and an inability to control proliferation, compounds the problem. Although no U.S. forces were exposed to chemical or biological weapons in our latest conflict with Iraq, the future does not hold the promise that we will be as lucky the next time. And there will be a next time.

176 (AD-A-280360/9/XAB) **Role of portable instrumentation in monitoring a Comprehensive Test Ban Treaty. Annual report, January 1993-February 1994.** Stump, B.W.; Riviere-Barbier, F.; Chernoby, I.; Koch, K. Southern Methodist Univ., Dallas, TX (United States). Dept. of Geological Sciences. 13 Apr 1994. 266p. Contract F49620-93-1-0146. (SMU-5-25155). Source: NTIS Prices: PC A12/MF A03.

This report documents two efforts undertaken during the past 12 months. The first describes a combined near-source/regional monitoring of a series of mining blasts in Southern Russia. The second contribution describes a theoretical investigation of nuclear explosion source model resolution using near-source seismic data in a nonlinear inversion scheme. Mining explosion, Nuclear explosion, Seismic source function.

177 (AD-A-280535/6/XAB) **Beyond stalemate: Deterrence and nonproliferation in the new world order. Final report.** Vonnie, J.; Cole, D. Air Univ., Maxwell AFB, AL (United States). Air War Coll. Apr 1994. 32p. Source: NTIS Prices: PC A03/MF A01.

U.S. deterrence and nonproliferation policies need to be updated to meet the challenges of the new world order. To be effective, these new policies must be based on an understanding of potential proliferators motives for pursuing nuclear weapons, must be realistic, and must be implemented as early in the nuclear program as possible.

178 (AD-A-280611/5/XAB) **Lethal tide: The worldwide threat from cheap conventional arms. Final report.** King, C.D. Air Univ., Maxwell AFB, AL (United States). Air War Coll. Apr 1994. 46p. Source: NTIS Prices: PC A03/MF A01.

The twentieth century has seen as unprecedented explosion in the manufacture and use of armaments. This has been accompanied by steady increases in the number, length and lethality of conflicts. Both trends have been accelerating since the end of World War II, especially with regard to the so-called Third World. The focus of most arms control efforts has been on nuclear, chemical and biological weapons, with some secondary concern in the last two decades over sophisticated major conventional armaments. Virtually unnoticed have been the massive quantities of simple, inexpensive arms produced all over the globe and traded in channels overt, covert, and illegal. These items remain useful for many years. Equipment such as mortars and rifles find application in war after war, while ammunition keeps its explosive nature until it detonates. So the world,

especially the Third World, has an ever growing sea of cheap arms, the old stuff still dangerous, more added every day. Review of selected conflicts, including Cambodia and Afghanistan, illustrates the depth of the trouble we are in and suggests some possible future directions in order to avoid drowning in this lethal sea.

179 (AD-A–280623/0/XAB) **Nuclear threat on the Korean peninsula: The present and the future. Final report.** Kang, S. Air Univ., Maxwell AFB, AL (United States). Air War Coll. Apr 1994. 28p. Source: NTIS Prices: PC A03/MF A01.

Forty years after they were divided by the Cold War, South and North Korea are closer to reunification than ever before. However, North Korea's nuclear weapons program might cause South Koreans to be much less sure about reunification. Today the Cold War is over, but the Korean peninsula is still divided into two Koreas despite the new era of reconciliation. Since December 1991 when a nonaggression pact was signed barring nuclear weapons, North Korea has pursued its nuclear weapon development. In March 1993, North Korea declared its intention to withdraw from the Nuclear Non-Proliferation Treaty, and has been refusing a full inspection of its nuclear program. North Korea's nuclear issue is an international issue today. This paper discusses 'what threat we have today' and 'what should be done in the future.'.

180 (AD-A–280670/1/XAB) **Nuclear proliferation and Latin American Security: Is the 'bomb' program dead in Brazil. Master's thesis.** De Jesus, E. Naval Postgraduate School, Monterey, CA (United States). 24 Mar 1994. 157p. Source: NTIS Prices: PC A08/MF A02.

This thesis addresses the possibility of a Brazilian hidden agenda in order to support one of the most advanced nuclear research and nuclear power programs in Latin America. From the early 1970s to the late 1980s Brazilian military leaders pursued the development of nuclear weapons. With the emergence of democratic regimes during the 1980s, these covert projects were halted or terminated. The civilian administration in Brazil is now supporting an ambiguous and uncompromising position by not ratifying significant agreements renouncing nuclear weapons programs. With Brazil still rejecting the Non-Proliferation Treaty (NPT), not formally embracing the Tlatelolco Treaty (which prohibits nuclear weapons in Latin America), and not allowing full implementation of inspections and International Atomic Energy Association (IAEA) Safeguards on its nuclear facilities, the future of the Brazilian nuclear program appears to be a dormant but potential political factor in Brazilian foreign policy.

181 (AD-A–280807/9/XAB) **21st century US Chinese relationship: Partnership and cooperation or conflict and competition. Final report.** Peterson, Q.L. Air Univ., Maxwell AFB, AL (United States). Air War Coll. 1994. 28p. Source: NTIS Prices: PC A03/MF A01.

The transition from the Cold War's familiar, well-understood containment strategy to a new international security environment produces formidable challenges. Secretary of Defense Perry identifies national security interests that include prevention of proliferation of weapons of mass destruction, maintaining regional stability, and avoiding the re-establishment of an antagonistic global rivalry with Russia. Former Ambassador Vernon Walters highlights three great challenges the United States faces in the future, two of which are very similar to Secretary Perry's: to prevent proliferation and prevent Russia from returning to a revisionist Soviet Union. Of Significant importance, however, is Ambassador Walters' third challenge: prevent China from becoming the 'Soviet Union' of the next century. Given the thousands of nuclear weapons still possessed by Russia, President Clinton emphasizes that itis in the United States' national interest to 'work with Russia to lower the nuclear threshold, to support the development of Russia as a stable democracy and to help it develop a healthy market economy that can benefit both our peoples'. As important as a stable Russia is to the international security environment, the United States must not become so 'Russo-centric' that it loses perspective on other great nations – such as China. President Clinton's goals of lowering the nuclear threshold and developing a stable democracy and healthy market economy are as important for China is a key actor with respect to the United States and the global economic, political, and security environment – and will become even more important in the future.

182 (AD-A–280868/1/XAB) **Egyptian nuclear nonproliferation: The politics of a weak state. Master's thesis.** Pugh, J.P. Naval Postgraduate School, Monterey, CA (United States). Mar 1994. 135p. Source: NTIS Prices: PC A07/MF A02.

This thesis uses the available literature regarding Egypt's nuclear development program from 1952 to 1981 to show that a week state faces insurmountable structural restraints in developing nuclear weapons even if motivation and capability are present. According to international security conditions and initial science development in 1952, Egypt should have acquired nuclear weapons by 1970. Presidents Nasir and Sadat undermined the very Egyptian agencies they created to develop nuclear weapons technology. A state's international security motives and technology development are necessary but not sufficient conditions for nuclear proliferation. The necessary and sufficient condition is that the state be a strong state, able to extract resources from society and able to enact policies which require societal compliance. Weak state leaders cannot resolve the dilemma of opposing domestic security and international security priorities without obstructing their designated state agencies from developing nuclear weapons. United States nuclear nonproliferation policy must consider the political variable of state strength in order to determine the likelihood of proliferation.

183 (AD-A–280947/3/XAB) **Seismic identification analyses of cavity decoupled nuclear and chemical explosions. Technical report.** Murphy, J.R.; Barker, B.W. S-Cubed, San Diego, CA (United States). Jan 1994. 82p. Contract F19628-91-C-0186. (SCIENTIFIC–2). Source: NTIS Prices: PC A05/MF A01.

Successful seismic monitoring of any eventual Comprehensive Test Ban Treaty will require development of a capability to identify signals from small cavity decoupled nuclear explosions from among numerous signals to be expected from earthquakes, rockbursts and chemical explosion (CE) events of comparable magnitude. The investigations summarized in this report focus on preliminary studies which have been carried out in an attempt to distinguish between decoupled nuclear explosions and CE events though analyses of observed and simulated seismic data for these two source types in both the U.S. and former Soviet

Union. Near-regional seismic data recorded from the U.S. nuclear cavity decoupling test STERLING and the nearby tamped CE test STERLING HE are compared in Section II in an attempt to identify diagnostic differences between these two source types. This is followed in Section III by an analysis in which short-period P wave data recorded at NORSAR from Soviet nuclear tests conducted in salt cavities at Azgir site north of the Caspian Sea are systematically compared with corresponding data recorded at the same stations from presumed CE events of comparable size which have been located in the vicinity of Azgir site. In Secion IV, broadband seismic data recorded at near-regional Soviet stations from an Azgir nuclear cavity decoupling test are theoretically scaled to 1 kt fully decoupled level and compared with data recorded at the nearby IRIS station KIV from well-documented CE events. The results of these preliminary comparison studies indicate that seismic discrimination between these two explosion source types is not trivial and suggest that a reliable discrimination strategy will have to be based on detailed analysis of data.

184 (AD-A–282124/7/XAB) **Nuclear deposturing and US public opinion. Master's thesis.** Hinote, S.C. Air Force Inst. of Tech., Wright-Patterson AFB, OH (United States). 12 Apr 1994. 52p. (AFIT/CI/CIA–94-034). Source: NTIS Prices: PC A04/MF A01.

USSTRATCOM is currently developing a rational framework for evaluating deposturing alternatives that range from distancing the 'nuclear football' from the President to storing land-based ICBM's away from their soils. One of the areas that may be considered by USSTRATCOM when evaluating these alternatives is the political feasibility of implementing different alternatives. An important determinant of this political feasibility is domestic public opinion, as it can encourage or constrain the actions of the elected officials who are directly accountable to the people. This Policy Analysis Exercise helps USSTRATCOM take public opinion into account in the analysis by considering the views that U.S. citizens hold on defense issues and recommending how these views should be included in the evaluation of different deposturing measures.

185 (AD-A–282674/1/XAB) **North Korean Nuclear Program. What is to be done.** Wendt, J.C. Rand Corp., Santa Monica, CA (United States). 1994. 38p. Contract MDA903-91-C-0006. Source: NTIS Prices: PC A03/MF A01.

The purpose of this report is to provide a conceptual framework for choosing among alternative U.S. approaches to ending the North Korean nuclear program. This report is intended for policymakers and force planners in the U.S. government. It should also be of interest to a general audience concerned with the United States nonproliferation policy and Korean policy. This report first identifies important U.S. objectives affected by the North Korean nuclear weapons program. Then, it develops a framework for evaluating approaches for accomplishing these objectives. This framework is applied to several alternative approaches. On the basis of the objectives' priority, some approaches are found to be better than others. But no approach is likely to accomplish all U.S. objectives, at least not in the short term. Hence, we conclude that the United States must decide on the priority of its objectives and select an approach most likely to accomplish its most important objectives.

186 (AD-A–283003/2/XAB) **Radiation detection equipment (RED) comparative evaluation test program. Volume 1. Point source measurements. Technical report, 1 February 1993-31 July 1993.** McNeilly, J.H.; Rothstein, B.D. Science Applications International Corp., Newington, VA (United States). Center for Verification. 1 Aug 1994. 100p. Contracts DNA001-89-C-0204, DNA001-93-C-0083. Source: NTIS Prices: PC A05/MF A02.

Radiation detection equipment (RDE) will be used under the START Treaty to verify that air-launched cruise missiles (ALCM) declared to be non-nuclear do not contain nuclear warheads and to verify that certain containers do not contain radiation attenuating material. Under the Intermediate-Range Nuclear Forces (INF) Treaty, neutron RDE was used and it is proposed that the same RDE be used for the START Treaty. However, the On-Site Inspection Agency (OSIA) has established a requirement for commercially available, lighter weight and smaller equipment than the INF RDE. As a result of the OSIA requirements, the DNA undertook a test project to evaluate selected neutron RDE to determine if any of the available instrument could satisfy the START monitoring requirements. Several different RDE, including the INF RDE, were exposed to calibration sources at Andrews Air Force Base and the Los Alamos National Laboratory (LANL) and to actual nuclear warheads at LANL. The results of these tests indicated that, unless there are significant changes in the Treaty procedures related to neutron source strength, detector-to-source distance, and/or data accumulation time, only one commercially available RDE could favorably compared with the INF RDE. However, there would be little savings in weight or size.

187 (AD-A–283520/5/XAB) **Department of Defense Nuclear/Biological/Chemical (NBC) warfare defense. Annual report to Congress, June 1994. Final report, 1 October 1992-30 September 1993.** Assistant Secretary of Defense (Atomic Energy), Washington, DC (United States). 1 Jun 1994. 176p. Source: NTIS Prices: PC A09/MF A02.

The National Defense Authorization Act for Fiscal Year 1994, Public Law 103-160, Title XVII, Chemical and Biological Weapons Defense, section 1703, directed the Secretary of Defense to submit an assessment and a description of plans to improve readiness. The DoD objective is to enable our forces to survive, fight and win in NBC contaminated environments. Discussed are new management objectives impacted by declining resources and force structure versus an ever changing threat environment. Nuclear biological, Chemical, NBC, Defense, Logistics, Readiness, Training, Contamination avoidance, Protection, Decontamination.

188 (AD-A–283932/2/XAB) **Command and control in new nuclear states: Implications for stability. Master's thesis.** Foley, D.C. Naval Postgraduate School, Monterey, CA (United States). Jun 1994. 94p. Source: NTIS Prices: PC A05/MF A01.

Command and control systems of new nuclear states are likely to fail when placed under stress. This thesis will demonstrate that such failures can dramatically affect regional or international stability. Describing the current argument over the consequences of nuclear proliferation between proliferation pessimists and deterrence optimists, this thesis shows how C2 is in fact the crux of the debate. This thesis develops an analytical tool that may be applied to new nuclear states in order to classify their C2 systems and

to predict when and how these evolving systems might fail. To show the tool's usefulness, it is applied to Ukraine, an important new nuclear state. This thesis also suggests several implications for U.S. foreign policy. Nuclear weapons, Command and control, Proliferation, Arms control, Regional stability, Russia, United States, Ukraine, Nuclear capabilities, U.S. Security policy.

189 (AD-A-283937/1/XAB) **Proliferation and nonproliferation in Ukraine: Implications for European and US security. Final report.** Blank, S.J. Army War Coll., Carlisle Barracks, PA (United States). Strategic Studies Inst. 1 Jul 1994. 47p. Source: NTIS Prices: PC A03/MF A01.

The author explores the background, terms, and aftermath of the January 1994 tripartite agreement among Russia, Ukraine, and the United States concerning the removal of nuclear missiles located in Ukraine after the fall of the Soviet Union. Inasmuch as Ukraine is the true Russian window on Europe and the key determinant of whether a post-Soviet empire or unitary state can be recreated, the security dilemmas it faces are significant not only to Russia and Ukraine's European neighbors, but also to the United States. The author also examines the nature of Russia's threat to Ukraine and the implications of the new agreement for U.S. policy vis-a-vis Ukraine and Russia.

190 (AD-A-284272/2/XAB) **ERDEC contribution to the 1993 international treaty verification round robin exercise 4. Final report.** Rohrbaugh, D.K.; Beaudry, W.T.; Bossle, P.C.; Lochner, M.J. Edgewood Research, Development and Engineering Center, Aberdeen Proving Ground, MD (United States). Jul 1994. 112p. (ERDEC-TR-176). Source: NTIS Prices: PC A06/MF A02.

In March 1993, the U.S. Army Edgewood Research, Development and Engineering Center along with 16 other laboratories, participated in the 4th International Treaty Verification Round Robin Exercise. The objective of the exercise was to evaluate the current recommended operating procedures for the analysis of scheduled compounds in soil and water matrices. Eleven spiked samples and blanks resulting from three different types of soil and one source of water were received. Analytical methods used to analyze the samples were GC/FID/FPD, GC/MS (EI and methane CI) , NMR (1H, 13C, and 31P), and HPLC/ion chromatography. Four schedule 2 degradation products of VX and BZ (methylphosphonic acid, 2-diisopropylamino-ethanol, 3-quinuclidinol, and benzilic acid) were unambiguously identified and quantitated in the samples. This report summarizes the analytical methodology used in this round robin and the results obtained. Round robin, Treaty verification, Water and soil samples.

191 (AD-A-284834/9/XAB) **Evaluation of temperature compensated bubble dosimeters for treaty verification applications.** Baker, B.W. Naval Academy, Annapolis, MD (United States). 19 May 1994. 122p. (USNA-TSPR-211). Source: NTIS Prices: PC A06/MF A02.

Due to the drawdown of nuclear weapons through treaties among countries and the possible proliferation of nuclear weapons to the Third World, the Defense Nuclear Agency is investigating different methods that can be used to distinguish nuclear from non-nuclear munitions. Due to its small size, lack of electronics, and non-obtrusive data collection capability, the bubble dosimeter is a candidate for this process. The objective of this research is to investigate the response of alternate droplet material bubble dosimeters as it pertains to arms control verification procedures. This was accomplished by theoretically and experimentally studying (1) the bubble dosimeter's response to warhead neutron intensity and energy, (2) the bubble dosimeter's sensitivity to gamma radiation, (3) the bubble dosimeter's response as a function of temperature, and (4) the bubble dosimeter's response as a function of neutron energy. Conclusions are drawn regarding the potential use of bubble dosimeters for treaty verification applications. Through research on simulated warhead sources, practical procedures are outlined for using the bubble dosimeter to distinguish nuclear from non-nuclear munitions.

192 (AD-A-285251/5/XAB) **Of carrots and sticks or air power as a nonproliferation tool.** Wolf, F.R. California Univ., Berkeley, CA (United States). Jul 1994. 60p. Source: NTIS Prices: PC A04/MF A01.

The proliferation of nuclear weapons has become one of the principal threats to international peace and security. Postwar revelations from Iraq demonstrate how close a determined nation can come to covertly developing nuclear weapons without detection. In the past two years the issue of nonproliferation has increased in importance and the regime is becoming more intrusive. On the other hand, a number of nations hostile to the international order are attempting to develop or otherwise obtain nuclear weapons These states include North Korea, Iran, and Iraq. This paper argues that the use or threat of force must be incorporated into the nonproliferation regime. When properly integrated into nonproliferation strategy, force offers positive effects in terms of deterrence, compellence, and defense. Thus, the paper calls for the institutionalization of force options into the nonproliferation tool kit, ideally as part of chapter 7 enforcement actions under the authority of the UN Security Council.

193 (AD-A-285523/7/XAB) **Future gulf dynamics and US security.** Nardulli, B.; Agmon, M.; Karasik, T.; Kechichian, J.A.; Morris, M.E. Rand Corp., Santa Monica, CA (United States). 1994. 88p. Contracts F49620-91-C-0003, MDA903-91-C-0006. Source: NTIS Prices: PC A05/MF A01.

This documental briefing synthesizes the results of a research project, entitled 'Future Security Requirements for the Gulf.' It represents an effort to pull together much of the detailed work conducted during this project and focuses on the principal factors driving the future environment in the greater Gulf region, on the implications of the resulting findings for future Gulf security and for the U.S. regional posture in the area, and on a broad examination of alternative U.S. approaches to its security in the Gulf. The overall project objective was to provide a political-military assessment of security prospects in the Gulf over the next 3 to 5 years, challenges the U.S. military are likely to encounter as they support U.S. national objectives in the region, and the broader implications for future U.S. security planning.

194 (AD-A-285572/4/XAB) **Russian policy and the Korean crisis. Final report.** Blank, S.J. Army War Coll., Carlisle Barracks, PA (United States). Strategic Studies Inst. 30 Sep 1994. 37p. Source: NTIS Prices: PC A03/MF A01.

The author relates Russian policy to the broader struggle for power and coherence in Russian security policy generally, and in Russian policy towards Asia. He also explores the ambivalence of Russia's position, trying to maintain a

foot in all camps on the Korean issue even as it asserts its opposition to nuclear proliferation and to any settlement from which it is excluded. The author concludes by expanding his frame of reference to use the Russian case as an example illustrating the difficulties inherent in moving to a new, broader Northeast Asian security system.

195 (AD-A–285796/9/XAB) **Evaluation of a Multiple Instruction/Multiple Data (MIMD) parallel computer for CFD applications. Final report, April 1991-November 1992.** Schraml, S.J. Army Research Lab., Watertown, MA (United States). Oct 1994. 30p. (ARL-TR–589). Source: NTIS Prices: PC A03/MF A01.

In an attempt to evaluate the merits of massively parallel processing computers for the numerical simulation of blast phenomena, the U.S. Army Research Laboratory (ARL) has adapted one of its blast modeling tools to several unique parallel architectures. This report describes the adaptation of the BRL-QID code, a quasi-one-dimensional, finite difference Euler solver, to the Intel iPSC/860 parallel supercomputer. The code was reconfigured for the iPSC/860 using FORTRAN 77 and the Intel iPSC/860 message-passing library. The performance of the code was measured on the iPSC/860 for a variety of problem sizes and processor configurations. The performance was found to be highly dependent on the size of the problem. This problem size dependency was most noticeable when fewer processors were employed. Results of scalability tests indicate that the code performance scales in a roughly linear fashion about extrapolated lines of ideal performance. Nuclear explosion simulation, Shock tubes, Computer programming.

196 (AD-A–285846/2/XAB) **Epscor supplemental grant for an application of neural networks to seismic signal discrimination. Technical report.** Cercone, J.A.; Martin, J.R. Tech Foundation, Inc., Montgomery, WV (United States). 11 Apr 1994. 94p. Contract F19628-91-K-0039. Source: NTIS Prices: PC A05/MF A01.

The EPSCoRe Supplemental Grant for An Application of Neural Networks to Seismic Signal Discrimination was used to fund a Graduate Student for work with a parent ARPA project. The students course and research activities are presented along with a copy of the completed Masters Thesis based on the application of an ARMA model for seismic event discrimination.

197 (AD-A–285848/8/XAB) **Application of neural networks to seismic signal discrimination research findings. Final report, 12 December 1991-11 April 1994.** Cercone, J.A.; Clark, W.M.; Fuller, J.J.; Goodman, S.; Smith, D.J. Tech Foundation, Inc., Montgomery, WV (United States). 11 Apr 1994. 110p. Contract F19628-91-K-0039. Source: NTIS Prices: PC A06/MF A02.

Research focused on identification and collection of a suitable database, identification of parametric representation of the time series seismic waveforms, and the training and testing of neural networks for seismic event classification. It was necessary to utilize seismic events that had a high degree of reliability for accurate training of the neural networks. The seismic waveforms were obtained from the Center for Seismic Studies and were organized into smaller databases for training and classification purposes. Unprocessed seismograms were not well suited for presentation to a neural network because of the large number of data points required to represent a seismic event in the time domain. The parametric representation of the seismic events in some cases provided adequate information for accurate event classification, while significantly reducing the minimum size of the neural network. Various networks have achieved classification rates ranging from 88 percent classification of three class problem to 75 percent for the 5 class problem. The results vary dependent on the number of classes and the method of parametric transformations utilized. Multiple tests were performed in order to statistically average the training and classification rates. Test summaries presented and individual test results are given in the appendix.

198 (AD-A–285891/8/XAB) **Asian security challenges-planning the face of strategic uncertainties. Volume 1. Main report. Technical report, 13 February 1990-30 July 1993.** Martin, J.J.; Cockell, W.A.; Kraus, G.F.; Weaver, G.J. Science Applications International Corp., San Diego, CA (United States). 1 Oct 1994. 193p. Contract DNA001-89-C-0158. Source: NTIS Prices: PC A09/MF A03.

See also Volume 2, AD-A285 892.

This two-volume report describes an improved approach to DoD strategic planning and net assessments in the post cold-war security environment in Asia. Drawing in part on business-planning concepts, the approach is built around the concepts of strategic intent, shaping the security environment, adaptive strategies, and military core competencies. This volume describes and explains the approach. Net assessments, Adaptive strategies, Strategic planning, Military core competencies, Asian security environment, Shaping the security environment.

199 (AD-A–285892/6/XAB) **Asian security challenges-planning in the face of strategic uncertainties. Volume 2. Appendices. Technical report, 13 February 1990-30 July 1993.** Cockell, W.A.; Kraus, G.F.; Weaver, G.J. Science Applications International Corp., San Diego, CA (United States). 1 Oct 1994. 163p. Contract DNA001-89-C-0158. Source: NTIS Prices: PC A08/MF A02.

See also Volume 1, AD-A285 891.

This two-volume report describes an improved approach to DoD strategic planning and net assessments in the post cold-war security environment in Asia. Drawing in part on business-planning concepts, the approach is built around the concepts of strategic intent, shaping the security environment, adaptive strategies, and military core competencies. This volume contains appendices on business-planning concepts, military core competencies, and detailed net assessment techniques. Net assessments, Adaptive strategies, Strategic planning, Military core competencies, Asian security environment, Shaping the security environment.

200 (AD-A–285960/1/XAB) **Reentry vehicle on-site inspection technology study. Technical report, 6 March 1992-19 May 1993.** Abe, M.C. Army Research Lab., Adelphi, MD (United States). 1 Nov 1994. 116p. Contract DNA-MIPR-92-610. Source: NTIS Prices: PC A06/MF A02.

A study group was tasked to develop possible reentry vehicle on-site inspection (RVOSI) scenarios and to recommend research into technologies that could address these scenarios. The task was accomplished by identifying RVOSI technology candidates and evaluating their advantages or disadvantages to comparison to the visual protocol for RVOSI prescribed by the Strategic Arms Reduction Treaty

(START) on the Reduction and Limitation of Strategic Offensive Arms. RVOIS technologies were evaluated with regard to inspection confidence, cost, intrusiveness, operational impact, and inspector burden. The RVOSI Technology Study identified no technology that readily solves the problems associated with START-prescribed visual inspection protocols. Recommendations for (1) further research in analytic modeling, (2) experimental studies to support this analytic work, and (3) data processing resulted from this study. Technology development for RVOIS appears to be primarily of interest if the technology provides enhanced confidence or additional inspection capability over visual inspections.

201 (ANL/ACTV–95/1) **APSTNG: Associated particle sealed-tube neutron generator studies for arms control. Final report on NN-20 Project ST220.** Rhodes, E.; Dickerman, C.E.; Brunner, T.; Hess, A.; Tylinski, S. Argonne National Lab., IL (United States). Dec 1994. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE95009651. Source: OSTI; NTIS; GPO Dep.

Argonne National Laboratory has performed research and development on the use of Associated Particle Sealed-Tube Neutron Generator (APSTNG) technology for treaty verification and non-proliferation applications, under funding from the DOE Office of Nonproliferation and National Security. Results indicate that this technology has significant potential for nondestructively detecting elemental compositions inside inspected objects or volumes. The final phase of this project was placement of an order for commercial procurement of an advanced sealed tube, with its high-voltage supply and control systems. Procurement specifications reflected lessons learned during the study. The APSTNG interrogates a volume with a continuous 14-MeV neutron flux. Each neutron is emitted coincident with an "associated" alpha-particle emitted in the opposite direction. Thus detection of an alpha-particle marks the emission of a neutron in a cone opposite to that defined by the alpha detector. Detection of a gamma ray coincident with the alpha indicates that the gamma was emitted from a neutron-induced reaction inside the neutron cone: the gamma spectra can be used to identify fissionable materials and many isotopes having an atomic number larger than that of boron. The differences in gamma-ray and alpha-particle detection times yield a coarse measurement of the distance along the cone axis from the APSTNG emitter to each region containing the identified nuclide. A position-sensitive alpha detector would permit construction of coarse three-dimensional images. The source and emission-detection systems can be located on the same side of the interrogated volume. The neutrons and gamma rays are highly penetrating. A relatively high signal-to-background ratio allows the use of a relatively small neutron source and conventional electronics.

202 (ANL/DIS/CP–82577) **Environmental and safety obligations of the Chemical Weapons Convention.** Tanzman, E.A. Argonne National Lab., IL (United States). 7 Apr 1994. 5p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract DNA-001-90-C-0177. (CONF-9404140–1: American Society of International Law annual meeting, Washington, DC (United States), 7 Apr 1994). Order Number DE94010457. Source: OSTI; NTIS; GPO Dep.

Among its many unique and precedent-setting provisions, the Chemical Weapons Convention (CWC) includes important requirements for States Parties to protect the public safety and the environment in the course of carrying out the treaty. These obligations will apply to the destruction of chemical weapons, of former chemical weapons production facilities, and to other activities under the Convention such as the verification scheme. This morning, I will briefly discuss the Convention's safety and environmental obligations, concentrating on their effects in this country as the United States chemical weapons stockpile is destroyed.

203 (ANL/DIS/CP–84532) **Keeping the peace green: Integrating arms control and environmental protection.** Tanzman, E.A. (Argonne National Lab., IL (United States)); Kellman, B. Argonne National Lab., IL (United States). 21 Oct 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE95005615. Source: OSTI; NTIS; GPO Dep.

This talk is about how to avoid turning swords into Superfund sites. The problem we address is the potential conflict between the desire to take advantage of the greater international security brought by the end of the Cold War by entering arms control agreements requiring various military weapons to be dismantled, and the desire to avoid further degrading the environment in the process of destroying them. We will use as an illustration of these issues the Chemical Weapons Convention (CWC), which is intended to cause the destruction of all chemical weapons in the world. First, we will provide a brief overview of the CWC, then we will focus in on its environmental provisions, and, finally, we will discuss potential conflicts with United States law and how they might be resolved.

204 (ANL/DIS/CP–84533) **Fourth and Fifth Amendment issues raised by Chemical Weapons Convention inspections.** Tanzman, E.A. (Argonne National Lab., IL (United States). Economics and Law Section). Argonne National Lab., IL (United States). 21 Oct 1994. 13p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract DNA001-90-C-0177. (CONF-9410265–1: Continuing legal education seminar on legal implications for business of the chemical weapons convention, Philadelphia, PA (United States), 21 Oct 1994). Order Number DE95004600. Source: OSTI; NTIS; GPO Dep.

The Chemical Weapons Convention (CWC) offers a unique challenge to the United States system of constitutional law. This discussion is about the Fourth and Fifth Amendment issues raised by the CWC and about how federal implementing legislation can allow verification inspections to take place in the United States under the Chemical Weapons Convention while remaining in compliance with the Constitution. By implementing legislation, the author means a federal statute that would be enacted separately from Senate approval of the Convention itself. Although implementing legislation is a relatively unusual accompaniment to a treaty, it will be necessary to the CWC, and the Administration has submitted a bill that was under consideration in the last Congress and presumably will be reintroduced early next year. The Fourth and Fifth Amendment problems posed by the CWC arise from the verification inspection scheme embodied in the treaty. The CWC depends heavily on on-site inspections to verify compliance

with its key requirements. These include destroying all chemicals weapons stockpiles and bringing potential chemical weapons precursors under international control. The Convention contains four distinct kinds of inspections: systematic inspections of chemical weapons storage and destruction facilities, routine inspections of various declared facilities, challenge inspections, and a variant on challenge inspections in cases of alleged use of chemical weapons. All inspections are supposed to be only as intrusive as necessary to carry out the Convention. These inspections will be carried out by inspectors employed by the Organization for the Prohibition of Chemical Weapons (OPCW), located in The Hague, which is responsible for enforcing the Convention. Generally, the inspected State Party is permitted to assign observers to accompany the inspectors.

205 (ANL/DIS/CP–84908) **Legal aspects of national implementation of the Chemical Weapons Convention.** Tanzman, E.A. (Argonne National Lab., IL (United States)); Zeuli, A.R.; Kellman, B. Argonne National Lab., IL (United States). 28 Nov 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9411163–1: Regional seminar on the national implementation of the chemical weapons convention, Jakarta (Indonesia), 28 Nov 1994). Order Number DE95004635. Source: OSTI; NTIS; GPO Dep.

The author discusses some legal aspects of measures at the national level to implement the Chemical Weapons Convention (CWC). These implementing measures are universal, applying not only to the few States Parties that will declare and destroy chemical weapons, but also to the many States Parties that have never had a chemical weapons program. This new need for national measures to implement multilateral arms control agreements has generated unease due to a perception that implementation may be burdensome and at odds with national law. In 1993, concerns arose that the complexity of integrating the treaty with national law would cause each nation to effectuate the Convention without regard to what other nations were doing, thereby engendering significant disparities in implementation steps among States Parties. The author discusses progress among several States in actually developing national CWC implementing measures. Implementing measures from Australia, Norway, South Africa, and Sweden were available to him in English through the PTS. He compares them in order to illustrate different approaches to national implementation that are emerging. Of course, it is important to note that this brief survey necessarily omitted examination of the existing "background" of other, related domestic laws that these signatories might also have adopted that affect CWC implementation.

206 (ANL/RA/CP–80736) **Physics studies of weapons plutonium disposition in the IFR closed fuel cycle.** Hill, R.N.; Wade, D.C.; Liaw, J.R.; Fujita, E.K. Argonne National Lab., IL (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940407–14: Topical meeting on advances in reactor physics, Knoxville, TN (United States), 11-14 Apr 1994). Order Number DE94007641. Source: OSTI; NTIS; INIS; GPO Dep.

The core performance impact of weapons plutonium introduction into the IFR closed fuel cycle is investigated by comparing three disposition scenarios: a power production mode, a moderate destruction mode, and a maximum destruction mode all at a constant heat rating of 840 MWt. For each scenario, two fuel cycle models are evaluated: cores using weapons material as the sole source of transuranics in a once-through mode, and recycle corns using weapons material only as required for a make-up feed. Calculated results include mass flows, detailed isotopic distributions, neutronic performance characteristics, and reactivity feedback coefficients. In general, it is shown that weapons plutonium feed does not have an adverse impact on IFR core performance characteristics.

207 (ANL/TD/CP–82235) **The RERTR Program: Past, present and future.** Woodruff, W.L.; Travelli, A.; Matos, J.E.; Snelgrove, J.L. Argonne National Lab., IL (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940407–16: Topical meeting on advances in reactor physics, Knoxville, TN (United States), 11-14 Apr 1994). Order Number DE94008460. Source: OSTI; NTIS; GPO Dep.

The past, present and future of the Reduced Enrichment for Research and Test Reactor (RERTR) Program are discussed with an emphasis on some of the reactor physics and thermal-hydraulics codes and modelling required to accommodate research and test reactor analysis, and some of the development work still in progress is described. Some comparisons with physical measurements and Monte Carlo are provided. The efforts in fuels development and the experimental support are summarized. The accomplishments in joint study programs and the transfer of technology are high lighted. The joint study with the Russian reduced enrichment program presents many new challenges.

208 (ANL/TD/CP–82760) **Using low-enriched uranium in research reactors: The RERTR program.** Travelli, A. Argonne National Lab., IL (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9404154–1: Conference on peaceful uses of nuclear energy and nonproliferation, Bariloche (Argentina), 19-21 Apr 1994). Order Number DE94011507. Source: OSTI; NTIS; INIS; GPO Dep.

The goal of the RERTR program is to minimize and eventually eliminate use of highway enriched uranium (HEU) in research and test reactors. The program has been very successful, and has developed low-enriched uranium (LEU) fuel materials and designs which can be used effectively in approximately 90 percent of the research and test reactors which used HEU when the program began. This progress would not have been possible without active international cooperation among fuel developers, commercial vendors, and reactor operators. The new tasks which the RERTR program is undertaking at this time include development of new and better fuels that will allow use of LEU fuels in all research and test reactors; cooperation with Russian laboratories, which will make it possible to minimize and eventually eliminate use of HEU in research reactors throughout the world, irrespective of its origin; and development of an LEU-based process for the production of ^{99}Mo. Continuation and intensification of international cooperation are essential to the achievement of the ultimate goals of the RERTR program.

209 (BNL–49974) **Managed Access by Controlled Sensing (MACS).** Curtiss, J.A.; Indusi, J.P. Brookhaven National Lab., Upton, NY (United States). [1994]. 7p. Sponsored by Department of Defense, Washington, DC (United

States). DOE Contract AC02-76CH00016. (CONF-940748–76: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94016734. Source: OSTI; NTIS; GPO Dep.

During chemical weapons challenge inspections, the CWC treaty allows "alternate means" of access to be proposed by the nation challenged. BNL's Safeguards, Safety and Nonproliferation Division is funded by the Defense Nuclear Agency to develop a system to provide the challenge inspection team with a "virtual presence" within the facility while denying personal access. A general purpose configuration of a mobile station manned by site personnel and a base station manned by the challenge inspector, supported by a flexible communication system, will allow facility personnel to tailor the basic model to their site. Design of the MACS system is based on maximum use of commercial equipment that is available on the international market. Design requirements for the MACS system include methods of establishing geographical position, distance measuring equipment for use in verifying dimensions on floor plans, video and two-way audio links between the mobile unit and the base station, and portability and versatility of the equipment. The MACS platform will also support deployment of selected instrumentation which the site may offer to the challenge inspection team. This paper describes the design and construction of the prototype MACS system.

210 (BNL–60021) **A combined volumetric verification procedure based on bubble-tube manometry and lutetium spike.** Lemley, J.R. (Brookhaven National Lab., Upton, NY (United States)); Suda, S.; Keisch, B.; Belew, W.; Smith, D.H. Brookhaven National Lab., Upton, NY (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940748–77: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94016730. Source: OSTI; NTIS; GPO Dep.

Bubble-tube manometry is the most accurate currently available method for precision volumetric measurements of solutions in process tanks containing special nuclear materials. Bubble tubes installed in the accountability tank by the facility operator are instrumented with a precision pressure transducer and a programmable pneumatic multiplexing system. In a process-solution measurement technique currently under development, a spike solution containing a known amount of lutetium is added to the Accountability appropriate measures are taken to homogenize the tank contents, and a sample of the homogenized solution is analyzed by isotopic dilution mass spectrometry. Each method offers unique advantages when applied to independent verification of the special nuclear material content of process solutions for the purposes of international safeguards. The methods are compared with regard to attributes such as intrusiveness, authentication independent of the facility operator, value for process operations, suitability for continuous unattended process monitoring, technical implementation challenges, accuracy, inspection effort and cost. A solution-volume verification proce-dure emphasizing the complementary aspects of both methods is proposed.

211 (BNL–60043) **The CFE Treaty and changed conditions in Europe.** Allentuck, J. Brookhaven National Lab., Upton, NY (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940748–75: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94016729. Source: OSTI; NTIS; GPO Dep.

The Treaty on Conventional Forces in Europe (CFE) was signed in November 1990 by sixteen nations, members of the North Atlantic Treaty Organization (NATO), and six nations, members of the Warsaw Treaty Organization (WTO). It was resigned to prevent a major surprise attack in Europe by the conventional forces of one Treaty Organization against those of the other and was the first major arms control treaty to address conventional weapons. This paper focuses on how CFE adapted to changes in the military-political situation in Europe which occurred after 1990 and failed to adapt to others. Suggestions are offered on how it might be changed to make it more relevant under these changed conditions.

212 (BNL–60057) **Taxonomy of potential international safeguards regimes.** Lemley, J.R.; Allentuck, J. Brookhaven National Lab., Upton, NY (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940748–74: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94016731. Source: OSTI; NTIS; GPO Dep.

Since the International Atomic Energy Agency's (IAEA) search for the components of Iraq's nuclear weapons program under the auspices of the United Nations Security Council, a consensus for enhancing, strengthening or expanding the scope of international safeguards has developed. Some of the enhanced safeguards concepts which have been suggested include the following: short-notice, challenge, and random inspections; effluent monitoring in onsite, near site, and fly-by modes; local and wide-area environmental monitoring; and utilization of data from space-platform sensors. Potential safeguards regimes can be classified according to the functional and technical criteria which would be necessary for implementation of various enhanced safeguards concepts. While the nature of the regime which will emerge cannot be predicted, the classification of possible regimes according to major characteristics can be useful for identifying functional criteria and implementation challenges, focusing development efforts on the functional criteria, and planning for efficient use of safeguards resources. Precedents established in previously negotiated treaties – the Chemical Weapons Convention, the Treaty on Conventional Forces in Europe, START, and Open Skies – are examined with regard to enhancement of the international safeguards regime for nuclear and other weapons of mass destruction. Bilateral, multilateral and regional integration of enhanced safeguards elements is considered.

213 (BNL–60884) **Accelerator-driven assembly for plutonium transformation (ADAPT).** Van Tuyle, G.J.; Todosow, M.; Powell, J.; Schweitzer, D. Brookhaven National Lab., Upton, NY (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-950110–7: 12. symposium on space nuclear power and propulsion, Albuquerque,

NM (United States), 8-12 Jan 1995). Order Number DE95002415. Source: OSTI; NTIS; GPO Dep.

A particle accelerator-driven spallation target and corresponding blanket region are proposed for the ultimate disposition of weapons-grade plutonium being retired from excess nuclear weapons in the US and Russia. The highly fissile plutonium is contained within .25 to .5 cm diameter silicon-carbide coated graphite beads, which are cooled by helium, within the slightly subcritical blanket region. Major advantages include very high one-pass burnup (over 90 %), a high integrity waste form (the coated beads), and operation in a subcritical mode, thereby minimizing the vulnerability to the positive reactivity feedbacks often associated with plutonium fuel.

214 (BNL--61066) **Options for monitoring the US Russian bilateral cutoff agreement on shutdown of plutonium production reactors.** Sanborn, J. (Brookhaven National Lab., Upton, NY (United States)); Fishbone, L.G.; Lu, Minh-Shih; Stanbro, W.; Libby, R. Brookhaven National Lab., Upton, NY (United States). Jul 1994. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE95005701. Source: OSTI; NTIS; INIS; GPO Dep.

Six options are presented for monitoring operating Russian reactors and reprocessing plants under the bilateral cutoff agreement. In order of increasing intrusiveness they are: (A) monitoring of product (oxide or metal) storage only, supplemented with transparency measures at the reactors, (B) monitoring of product storage and reactor operating parameters, to assess reactor plutonium production, (C) monitoring of product storage, reactor operating parameters, and the input accountability tank of the reprocessing plant, (D) monitoring of product storage, the input accountability tank of the reprocessing plant, and application of surveillance to spent fuel, (E) IAEA/NPT-based material accountancy verification without major facility upgrades, and (F) IAEA/NPT-based safeguards, attempting to fulfill IAEA standards for material accountancy accuracy. Each of these options is considered in terms of cost, inspection effort, and effectiveness; however, the paper emphasizes the many uncertainties attendant on such assessments based on our current state of knowledge of these facilities.

215 (BNL--61304) **Routine inspection effort required for verification of a nuclear material production cutoff convention.** Fishbone, L.G.; Sanborn, J. Brookhaven National Lab., Upton, NY (United States). Dec 1994. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE95007309. Source: OSTI; NTIS; INIS; GPO Dep.

Preliminary estimates of the inspection effort to verify a Nuclear Material Cutoff Convention are presented. The estimates are based on (1) a database of about 650 facilities a total of eight states, i.e., the five nuclear-weapons states and three "threshold" states; (2) typical figures for inspection requirements for specific facility types derived from IAEA experience, where applicable; and (3) alternative estimates of inspection effort in cutoff options where full IAEA safeguards are not stipulated. Considerable uncertainty must be attached to the effort estimates. About 50–60% of the effort for each option is attributable to 16 large-scale reprocessing plants assumed to be in operation in the eight states; it is likely that some of these will be shut down by the time the convention enters into force. Another important question involving about one third of the overall effort is whether Euratom inspections in France and the U.K. could obviate the need for full-scale IAEA inspections at these facilities. Finally, the database does not yet contain many small-scale and military-related facilities. The results are therefore not presented as predictions but as the consequences of alternative assumptions. Despite the preliminary nature of the estimates, it is clear that a broad application of NPT-like safeguards to the eight states would require dramatic increases in the IAEA's safeguards budget. It is also clear that the major component of the increased inspection effort would occur at large reprocessing plants (and associated plutonium facilities). Therefore, significantly bounding the increased effort requires a limitation on the inspection effort in these facility types.

216 (CEA-N–2756, pp. 381-386) **Activation and gamma spectroscopy applied to the arms control.** Jaureguy, J.C. (DGA, 91 - Vert le Petit (France)); Dhermain, J.; Froment, D.; Nurdin, G.; Fuche, C.; Jezequel, S.; Bach, P. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. des Applications et de la Metrologie des Rayonnements Ionisants. May 1994. (In French). (CONF-9310279–: Three days on gamma and x-rays spectrometry, Saint-Remy-les-Chevreuse (France), 12-14 Oct 1993). In *Gamma and X 93 spectrometry.* 422p. Order Number DE95624754. Source: OSTI; NTIS (US Sales Only); INIS.

The control of disarmament needs non intrusive analysis methods. Many are available but one of the most promising is the neutron activation associated with gamma ray spectroscopy. The problem is to find out the composition of the content of a very often dangerous unknown object and the research has to be made through hermetic, strongly X-ray absorbing walls. By using thermal or fast neutrons it is possible to excite the nucleus of the various inner elements. Then, the nature of the content of the unknown object can be determined using gamma-ray spectroscopy. One present application is the identification of the toxic elements inside chemical ammunitions. (authors). 7 figs., 1 tab., 4 refs.

217 (CONF-9210428–) **New possibilities for a secure and just world.** Zagotta, W.E. (ed.). Lawrence Livermore National Lab., CA (United States). 28 Feb 1994. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CSTS–52-94). From New possibilities for a secure and just world; Berkeley, CA (United States); 2 Oct 1992. Order Number DE94010072. Source: OSTI; NTIS; GPO Dep.

More than a decade ago individuals from three significant institutions in East Bay Area began discussions in response to the apprehensions that were so deep in the early 1980s. These apprehensions were a result of the intense rhetoric between the two superpowers and the casual commentary about "limited nuclear war." The discussions spoke to the mortal danger as well as to the profound moral question revolving around nuclear arms. The issuance of the US Bishops' Pastoral on War and Peace in 1983 gave the group focus and momentum. The Chancellor at the University of California at Berkeley, the President of the Graduate Theological Union (the consortium of theological schools in Berkeley), and the Director of the Lawrence Livermore National Laboratory (one of the chief designers of American

nuclear arms) encouraged us to complete plans for a symposium. It was an era of activism. We chose, however, to serve the theme expressed by Albert Einstein, "Peace cannot be kept by force, it can only be achieved by understanding." After a decade, all of us can commend the leadership of the three institutions and the individuals involved for their perseverance. Their commitments to the pursuit of peace and to the development of an approach to manage the weapons of our time remain a concern of this group even though the great anxiety of a decade ago has subsided. We are now in a time different from that in which the Bishops' Pastoral was written. The talks of Fr. J. Bryan Hehir, Dr. Michael M. May, and Prof. Robert N. Bellah move into new areas of exploration; thus, our theme for this colloquium is "New Possibilities for a Secure and Just World." During our early encounters, one member of our founding group stated that: "This project will be a work of thirty years." Such a profound change in attitude may well be the work of an entire generation.

218 (CONF-9306366–1) **Optimal control for competitive-cooperative systems: Modeling flexible coalitions in tomorrow's competitive world.** Lenhart, S. (Oak Ridge National Lab., TN (United States)); Protopopescu, V. Oak Ridge National Lab., TN (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 61. Military Operations Research Society symposium at Wright-Patterson Air Force Base; Dayton, OH (United States); 22-24 Jun 1993. Order Number DE94018969. Source: OSTI; NTIS; GPO Dep.

The last years have witnessed a dramatic shift of the world's military, political, and economic paradigm from a bi-polar competitive gridlock to a more fluid, multi-player environment. This change has necessarily been followed by a re-evaluation of the strategic thinking and by a reassessment of mutual positions, options, and decisions. The essential attributes of the new situation are modeled by a system of nonlinear evolution equations with competitive/cooperative interactions. The mathematical setting is quite general to accommodate models related to military confrontation, arms control, economic competition, political negotiations, etc. Irrespective of the specific details, all these situations share a common denominator, namely the presence of various players with different and often changing interests and goals. The interests, ranging from conflicting to consensual, are defined in a context of interactions between the players that vary from competitive to cooperative. Players with converging interests tend to build up cooperative coalitions while coalitions with diverging interests usually compete among themselves, but this is not an absolute requirement (namely, one may have groups with converging interests and competitive interactions, and vice-versa). Appurtenance to a coalition may change in time according to the shift in one's perceptions, interests, or obligations. During the time evolution, the players try to modify their strategies as to best achieve their respective goals. An objective functional quantifying the rate of success (payoff) vs. effort (cost) measures the degree of goal attainment for all players involved, thus selecting an optimal strategy based on optimal controls. While the technical details may vary from problem to problem, the general approach described here establishes a standard framework for a host of concrete situations that may arise from tomorrow's "next competition".

219 **Nuclear data for safeguards and a possible comprehensive test ban treaty.** Boldeman, J.W. (Australian Nuclear Science & Technology Organization, Menai (Australia)). pp. 1108-1114 of Proceedings of the international conference nuclear data for science and technology. Volume 2. Dickens, J.K. (ed.). American Nuclear Society, Inc., La Grange Park, IL (United States) (1994). pp. 571 From International conference on nuclear data for science and technology: nuclear data for the twenty-first century; Gatlinburg, TN (United States); 9-13 May 1994.

Nuclear data needs for the effective application of international safeguards are discussed.

220 (CONF-941129–7) **Non destructive characterization using pulsed fast-thermal neutrons.** Womble, P.C. (Oak Ridge National Lab., TN (United States)); Schultz, F.J.; Vourvopoulos, G. Oak Ridge National Lab., TN (United States); Western Kentucky Univ., Bowling Green, KY (United States). Dept. of Physics and Astronomy. [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93PC93211 ; AC05-84OR21400. From 13. international conference on the application of accelerators in research and industry; Denton, TX (United States); 7-10 Nov 1994. Order Number DE95002601. Source: OSTI; NTIS; GPO Dep.

It has been shown that explosives, illicit drugs, and other contraband materials contain various chemical elements in quantities and ratios that differentiate them from each other and from other innocuous substances. In coal, the major chemical elements in it can provide information about various parameters of importance to the coal industry. In both examples, the nondestructive identification of chemical elements can be performed by utilizing incident pulsed fast-thermal neutrons that, through nuclear reactions, excite the nuclei of the various elements. This technique is being currently developed for dismantling of nuclear weapons classified as trainer's, and for on-line coal bulk analysis.

221 (CONF-9411201–1) **Detection of chemical agents, precursors and by-products using ion trap technology.** Lammert, S.A. (Oak Ridge National Lab., TN (United States)); Merriweather, R.; Sarver, E.W.; Wasseman, M.B. Oak Ridge National Lab., TN (United States). [1994]. 14p. Sponsored by Department of the Army, Washington, DC (United States);USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Project MIPRNo. 2311-1616. From Conference on chemical and biological defense research; Baltimore, MD (United States); 15-18 Nov 1994. Order Number DE95007031. Source: OSTI; NTIS; GPO Dep.

The utility of a new field portable ion trap-based instrument, the Generic Detector, for use in chemical weapons treaty verification is assessed. The ability of the instrument to detect targeted chemical agents, precursors and degradation products is examined. Instrumental characteristics (membrane vacuum interface, ion pump, air buffer gas) which resulted from, the reduction in size of the instrument are evaluated as to their impact on the detection limits for these selected compounds. Detection limits in the low nanogram range are obtainable for most of the chemical agents, precursors and by-products using both GC/MS and GC/MS/MS analysis.

222 (DOE–95020082) **Executive Branch Arms Control and Nonproliferation Directory.** USDOE, Washington,

DC (United States); PSR Services, Inc., Arlington, VA (United States). Aug 1994. 77p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI.

The purpose of this directory is to highlight the principal executive branch agencies, and within these agencies, the key individuals involved in arms control and nonproliferation policy activities. This directory is not a comprehensive listing of all players in the process, but rather is a selective listing of the primary players.

223 (DOE/AN/ACNT–94A) **Arms control and nonproliferation technologies: The non-proliferation experiment: First quarter 1994.** Staehle, G.; Stull, S.; Talaber, C. (eds.). USDOE Office of Arms Control and Nonproliferation, Washington, DC (United States). [1994]. 76p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94010308. Source: OSTI; NTIS; GPO Dep.

In this issue of Arms Control and Nonproliferation Technologies we present the initial findings of the recent Non-Proliferation Experiment (NPE), conducted by the Department of Energy at the Nevada Test Site. Through an introduction and pictorial walk-through, Marv Denny and Jay Zucca of Lawrence Livermore National Laboratory describe the overall experiment. This is followed by scientific and technical abstracts of the complex suite of experiments and analyses, which were presented at the Symposium on Non-Proliferation Experiment Results and Implications for Test Ban Treaties, April 19–21, 1994. Questions regarding the ongoing analysis and conclusions from the NPE should be directed to Leslie Casey in the Office of Research and Development within the Office of Nonproliferation and National Security of DOE. Her phone number is 202-586-2151.

224 (DOE/AN/ACNT–94B) **Arms Control and nonproliferation technologies: Technology options and associated measures for monitoring a Comprehensive Test Ban, Second quarter.** Lawrence Livermore National Lab., CA (United States). 1994. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94017542. Source: OSTI; NTIS; GPO Dep.

This newsletter contains reprinted papers discussing technology options and associated measures for monitoring a Comprehensive Test Ban Treaty (CTBT). These papers were presented to the Conference on Disarmament (CD) in May and June 1994. An interagency Verification Monitoring Task Force developed the papers. The task force included participants from the Arms Control and Disarmament Agency, the Department of Defense, the Department of Energy, the Intelligence Community, the Department of Interior, and the Department of State. The purpose of this edition of Arms Control and Nonproliferation Technologies is to share these papers with the broad base of stakeholders in a CTBT and to facilitate future technology discussions. The papers in the first group discuss possible technology options for monitoring a CTBT in all environments (underground, underwater, atmosphere, and space). These technologies, along with on-site inspections, would facilitate CTBT monitoring by treaty participants. The papers in the second group present possible associated measures, e.g., information exchanges and transparency measures, that would build confidence among states participating in a CTBT.

225 (DOE/AN/ACNT–94C) **Arms control and nonproliferation technologies, third quarter 1994: Dismantlement transparency.** Staehle, G.; Talaber, C.; Stull, S. (eds.). USDOE Office of Nonproliferation and National Security, Washington, DC (United States). 1994. 46p. Sponsored by USDOE, Washington, DC (United States). Order Number DE95001068. Source: OSTI; NTIS; GPO Dep.

The recent history-making agreements between the US and Russia to cooperate in dismantling existing nuclear weapons stockpiles point to the need for methods that can confirm, without revealing sensitive design information, that fissile material has indeed been removed from weapons. Methods for safe handling, storage, and transparent record-keeping are needed as well. The issue of Arms Control and Nonproliferation Technologies highlights the Department of Energy's current efforts in developing such technologies for nuclear weapon and fissile material control. Overview articles address the technical challenges of storage and inspection regimes for weapon components. Other articles present specific technologies for handling and dismantling components; for compliance with transportation requirements; for monitoring systems, both local and dispersed, based on nuclear radiation measurements; for monitoring without radiation detection; and for managing the immense amounts of information needed to track dismantled components. Selected papers are indexed separately for inclusion in the Energy Science and Technology Database.

226 (DOE/DP/50081–T3) **A chronology of Comprehensive Test Ban proposals, negotiations, and debates: 1945–1993.** Pounds, T.J. Science Applications International Corp., McLean, VA (United States). Jan 1994. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-92DP50081. Order Number DE94006338. Source: OSTI; NTIS; INIS; GPO Dep.

This document is a compilation of the comprehensive test ban proposals, negotiations and debates which took place between July, 1945 and October, 1993.

227 (DOE/ER/81672–T1) **Develop a holographic verification tag for secure inventory: Final technical report, 28 December 1993–17 July 1994.** Trolinger, J.D.; Weber, D. MetroLaser, Irvine, CA (United States). [1994]. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-94ER81672. Source: OSTI.

During the Phase I program, experiments were conducted to demonstrate the feasibility of two authentication tag concepts which incorporated the innovative use of complex reference beams to make them readable under normal light only if special conditions were met. The first approach, referred to as a surface referenced hologram, used the surface of the object it was made on as an intimate part of the hologram. The second approach, referred to as a Key/Tag hologram, used a complex wave front to record a tag hologram which could only be read when the same complex reconstruction wave front was produced by a separate "key" hologram which was placed on top of the tag. Both of these methods were successfully demonstrated. During the next phase, the surface referenced holographic concept was tested. The effort culminated in the production of two holograms that were made on an undulating surface using the two-step method. The surface referenced hologram provided a unique reference beam due to the light scattered from the surface itself. This scattered wave front was

recorded onto an intermediate hologram and played back onto the surface. The reflection of this scattered wave front back onto the surface produces the required collimated beam to make the surface reflection hologram. In the last phase of the laboratory work, the key/tag holographic concept was demonstrated. The existing laboratory breadboard was modified to produce a hologram that could not be reconstructed without the use of a second "key" hologram that contained the "code" wave front to unlock the contents of the first (tag) hologram. The laboratory work clearly demonstrated the feasibility of both of these concepts, resulting in a tag that would be extremely difficult and costly to duplicate by a counterfeiter; this represents a significant improvement over currently used methods.

228 (DOE/ER/81677–T1) **Highly versatile tunable multi-spectral imaging sensor based on micro spectrographic array filter concept. Final report, December 28, 1993–July 17, 1994.** Aye, T.M. Physical Optics Corp., Torrance, CA (United States). Div. of Applied Technology. Oct 1994. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-94ER81677. Source: OSTI.

Physical Optics Corporation (POC) investigated a unique nanotechnology in Phase I for the development of Cascaded Array Multispectral Imaging Sensors (CAMIS) that can provide realtime, spectrally tunable operation with unique spectral processing capabilities that has no moving parts. The proposed approach combined micro-optics, holographic dispersive components, highspeed spatial-light-modulators, and CCD detector arrays to achieve a compact, low voltage tunable multi-spectral imaging sensor array. Because of its potential for high spectral resolution and high speed, the system can provide simultaneous real-time target location and identification with very high accuracy. In Phase I, POC demonstrated not only the feasibility of the CAMIS concept and its advantages over existing techniques, but also demonstrated that all of the basic components of the system can be fabricated and integrated in a cost effective manner. Upon the successful completion of further investigation and optimization, POC is confident that the CAMIS nanotechnology approach wig produce a key breakthrough in multi-spectral imaging techniques, and will find major applications in both the government and commercial markets. POC's CAMIS technology will provide a new generation of highly versatile, low cost multispectral imaging sensors for remote sensing applications. This technology can also find many applications in biomedical spectroscopic imaging, laser radar, and optical communications.

229 (DOE/FTR–94005806) **Travel to Greece for the workshop in Arms Control and Security in the Middle East: Foreign trip report, December 31, 1993–January 1, 1994.** Pregenzer, A.L. Sandia National Labs., Albuquerque, NM (United States). 25 Jan 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94005806. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Workshop on Arms Control and Security in the Middle East was organized by Professor Steven Spiegel, a Middle East expert at the University of California at Los Angeles (UCLA). It was sponsored by the University of California Institute on Global Conflict and Cooperation (IGCC) with funding provided by the Office of Nonproliferation Policy at the Department of Energy. The workshop was attended by representatives from many Middle East countries, including Israel, Jordan, Egypt, Morroco, Kuwait, Oman, Yemen, and by representatives from the PLO. Israel sent a particularly high level delegation, which included Daviv Ivry, the Minister of Defense, and Shalheveth Freir, the former head of the Atomic Energy Commission. Fred Axelgard, the Middle East Arms Control coordinator at the US State Department, attended in an unofficial capacity. Half a day of the three-day workshop was devoted to presentations by John Taylor and myself on the Cooperative Monitoring Center (CMC) project at Sandia. This was the only technical presentation at the workshop. We received strong positive support for the CMC project, as well as many suggestions for better tailoring the presentations to a regional audience. Several opportunities for future contributions to the Middle East peace process were discussed at the end of the conference, including scheduling an intersessional meeting of the formal multilateral Middle East peace talks at Sandia.

230 (DOE/FTR–94006990) **Travel to Russia to aid in the establishment of the International Science and Technology Center: Foreign trip report, April 1–November 7, 1993.** DuCharme, A.R. Sandia National Labs., Albuquerque, NM (United States). 3 Feb 1994. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94006990. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Art DuCharme worked in Moscow during the trip period as three to four members of the US contingent to the ISTC Preparatory Committee. This Preparatory Committee is composed of representatives from the four Parties that are signatories to the original ISTC Agreement. These signatories are the US, Japan, Russia, and the European Community. The ISTC Preparatory Committee worked to prepare documents and procedures for formation of the ISTC, developed proposals for scientific projects to support Russian weapons scientists, and visited many Russian institutes and weapons facilities to inform themselves of Russian capabilities, and to promote the development of high quality proposals. Art DuCharme worked closely with Russian weapons scientists to develop technical proposals compatible with ISTC objectives and requirements. During this trip period, 46 proposals were prepared and sent out to the Parties for their early consideration.

231 (DOE/NN–0003) **Comprehensive Test Ban Treaty research and development FY95-96 program plan.** USDOE Office of Nonproliferation and National Security, Washington, DC (United States). Nov 1994. 58p. Sponsored by USDOE, Washington, DC (United States). Order Number DE95005149. Source: OSTI; NTIS; GPO Dep.

The Department of Energy (DOE) is responsible for the United States Government's (USG) research and development (R&D) functions for monitoring nuclear explosions in the context of a Comprehensive Test Ban Treaty (CTBT). This responsibility includes the November 1993 transfer of the Department of Defense's (DoD) CTBT R&D responsibility to DOE. The DOE research program builds on the broad base of USG expertise developed historically and includes R&D for detecting, locating, identifying, and characterizing nuclear explosions in all environments. The Office of Research and Development (NN-20), within the Department of Energy's Office of Nonproliferation and National Security, formulates and executes the efforts necessary to meet the

Department's responsibilities. The following DOE laboratories as a team will support NN-20 in implementing the program plan: Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Pacific Northwest Laboratory, and Sandia National Laboratories. DOE has committed to a cooperative program that draws upon the core competencies of the national laboratories and upon the strengths of other government agencies and the private sector (academia and industry). The integration of resources under a common direction will allow the program to be flexible and responsive to changing technical and policy requirements while maximizing the effectiveness of funding appropriations. DOE will develop and demonstrate appropriate technologies, algorithms, procedures, and integrated systems in a cost-effective and timely manner. The program comprises seismic, radionuclide, hydroacoustic, and infrasound monitoring; on-site inspection; space-based monitoring; and automated data processing elements.

232 (DOE/NV–209-Rev.14) **United States nuclear tests, July 1945 through September 1992.** USDOE Nevada Operations Office, Las Vegas, NV (United States). Office of External Affairs. Dec 1994. 107p. Sponsored by USDOE, Washington, DC (United States). Order Number DE95006143. Source: OSTI; NTIS; GPO Dep.

This document lists chronologically and alphabetically by name all nuclear tests and simultaneous detonations conducted by the United States from July 1945 through September 1992. Several tests conducted during Operation Dominic involved missile launches from Johnston Atoll. Several of these missile launches were aborted, resulting in the destruction of the missile and nuclear device either on the pad or in the air.

233 (DOE/SF/20218–T1) **Plutonium Consumption Program, CANDU Reactor Project final report.** AECL Technologies, Inc., Rockville, MD (United States). 31 Jul 1994. 399p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-94SF20218. Order Number DE94015772. Source: OSTI; NTIS; INIS; GPO Dep.

DOE is investigating methods for long term dispositioning of weapons grade plutonium. One such method would be to utilize the plutonium in Mixed OXide (MOX) fuel assemblies in existing CANDU reactors. CANDU (Canadian Deuterium Uranium) reactors are designed, licensed, built, and supported by Atomic Energy of Canada Limited (AECL), and currently use natural uranium oxide as fuel. The MOX spent fuel assemblies removed from the reactor would be similar to the spent fuel currently produced using natural uranium fuel, thus rendering the plutonium as unattractive as that in the stockpiles of commercial spent fuel. This report presents the results of a study sponsored by the DOE for dispositioning the plutonium using CANDU technology. Ontario Hydro's Bruce A was used as reference. The fuel design study defined the optimum parameters to disposition 50 tons of Pu in 25 years (or 100 tons). Two alternate fuel designs were studied. Safeguards, security, environment, safety, health, economics, etc. were considered. Options for complete destruction of the Pu were also studied briefly; CANDU has a superior ability for this. Alternative deployment options were explored and the potential impact on Pu dispositioning in the former Soviet Union was studied. An integrated system can be ready to begin Pu consumption in 4 years, with no changes required to the reactors other than for safe, secure storage of new fuel.

234 (DTH-AEF-NT–10) **The risk of nuclear weapons proliferation.** Oelgaard, P.L. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Afd. for Elektrofysik. Jan 1994. 28p. Order Number DE94636728. Source: OSTI; NTIS; INIS.

During the later years the risks of nuclear proliferation have again become a major topic of interest. This is primarily due to the acute problems caused by Iraq, North Korea, and the 3 new states of the former USSR, Ukraine, Kazakhstan and Belarus. Analysis shows that security problems and prestige are the two most important motives, when the risks of proliferation are considered. But motives are not enough. To produce nuclear weapons a number of technological requirements must also be fulfilled. The country must be able to produce almost pure fissile material, i.e. ^{235}U or ^{239}Pu. It must also be able to solve a number of metallurgical, explosive, ignition, physics and other problems. These are in particular non-trivial, if a implosion weapon is to be designed. A review is made of the nuclear facilities in a number of the countries which have been suggested as possible future nuclear weapons countries. In particular facilities which can produce almost pure fissile materials, ^{235}U and ^{239}Pu, are considered. The possibility of nuclear terrorists have often been discussed in the media. However, it seems very unlikely that even a major terrorist or mafia organization will be able to solve all the weapons design problems, even if they could steal the fissile material. It is finally discussed what can be done to reduce the risk of further nuclear proliferation. Political pressure can be brought to bear on countries outside the NPT to join it, but it can be counterproductive, and sometimes the countries that are able to exert such pressure, are not willing to do so for other political reasons. The problem of countries which are party to the NPT, but which are believed to acquire nuclear weapons capability in violation of the treaty, can be countered by unannounced inspections of non-declared facilities. However, such inspections can only be meaningfully performed if the necessary intelligence is available. (EG).

235 (IAEA-INFCIRC–426) **Agreement of 18 November 1993 between the Kingdom of Tonga and the International Atomic Energy Agency for the application of safeguards in connection with the treaty on the non-proliferation of nuclear weapons.** International Atomic Energy Agency, Vienna (Austria). Feb 1994. 220p. (In Arabic, Chinese, English, French, Russian, Order Number DE94622693. Source: OSTI; NTIS (US Sales Only); INIS.

The text of the Agreement (and the Protocol thereto) between the Kingdom of Tonga and the International Atomic Energy Agency for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons is reproduced in this document for the information of all Members. The Agreement was approved by the Agency's Board of Governors on 25 February 1975 and signed in Vienna on 31 October 1990 and in Nuku'Alofa on 18 November 1993.

236 (IAEA-INFCIRC–428) **The treaty for the prohibition of nuclear weapons in Latin America and the Caribbean (Tlatelolco Treaty).** International Atomic Energy Agency, Vienna (Austria). 14 Feb 1994. 12p. (In Arabic,

Chinese, English, French, Russian, Order Number DE94631082. Source: OSTI; NTIS (US Sales Only); INIS.

In a letter of 28 January 1994, the Director General was informed that on 18 January 1994, the Treaty for the Prohibition of Nuclear Weapons in Latin American and the Caribbean entered into force for the Argentine Republic.

237 (IAEA-INFCIRC–429) **Address by the Minister for Foreign Affairs of Algeria on the occasion of the inauguration of the "Es Salam" reactor on 21 December 1993.** International Atomic Energy Agency, Vienna (Austria). 18 Feb 1994. 29p. (In Arabic, Chinese, English, French, Russian, Order Number DE94622694. Source: OSTI; NTIS (US Sales Only); INIS.

The address contains the declaration that Algeria resolves to adhere to the Non-Proliferation Treaty.

238 (IAEA-INFCIRC–430) **Press release of 8 February 1994 issued by the Department of Foreign Affairs of the Philippines.** International Atomic Energy Agency, Vienna (Austria). 17 Feb 1994. 12p. (In Arabic, Chinese, English, French, Russian, Order Number DE94631083. Source: OSTI; NTIS (US Sales Only); INIS.

The attached text of the press release of 8 February 1994 issued by the Department of Foreign Affairs of the Philippines on the issue of inspections of nuclear sites in the Democratic People's Republic of Korea is being circulated to Member States at the request of the Permanent Mission of the Philippines.

239 (IAEA-INFCIRC–431) **The treaty for the prohibition of nuclear weapons in Latin America and the Caribbean.** International Atomic Energy Agency, Vienna (Austria). 21 Feb 1994. 45p. (In Arabic, Chinese, English, French, Russian, Order Number DE94631084. Source: OSTI; NTIS (US Sales Only); INIS.

The text of the statement, made by Ambassador Carlos Portales Cifuentes, Director General for Foreign Policy of the Ministry of External Relations of Chile, during the VIII. Special Session of the General Conference of the Agency for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (OPANAL) on the occasion of Chile's becoming a Contracting Party to the Tlatelolco Treaty, is being circulated for the information of all Member States of the Agency at the request of the Alternate to the Resident Representative of Chile.

240 (IAEA-INFCIRC–432) **Press release of 14 February 1994 issued by the Department of Foreign affairs of the Philippines.** International Atomic Energy Agency, Vienna (Austria). 23 Feb 1994. 12p. (In Arabic, Chinese, English, French, Russian, Order Number DE94631085. Source: OSTI; NTIS (US Sales Only); INIS.

The text of the press release of 14 February 1994 issues by the Department of Foreign Affairs of the Philippines on the issue of inspections of nuclear sites in the Democratic People's Republic of Korea is being circulated to Member States at the request of the Permanent Mission of the Philippines.

241 (IAEA-INFCIRC–434) **Agreement of 21 December 1993 between the Republic of Latvia and the International Atomic Energy Agency for the application of safeguards in connection with the treaty on the non-proliferation of nuclear weapons.** International Atomic Energy Agency, Vienna (Austria). Mar 1994. 217p. (In Arabic, Chinese, English, French, Russian, Order Number DE94631086. Source: OSTI; NTIS (US Sales Only); INIS.

The text of the Agreement between the Republic of Latvia and the International Atomic Energy Agency for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons is reproduced in this document for the information of all Members. The Agreement was approved by the Agency's Board of Governors on 2 December 1993 and signed in Vienna on 6 December 1993 and in Riga on 21 December 1993.

242 (IAEA-INFCIRC–436) **Communications dated 15 and 22 March 1994 received from the permanent mission of South Africa to the International Atomic Energy Agency.** International Atomic Energy Agency, Vienna (Austria). 14 Apr 1994. 18p. (In Arabic, Chinese, English, French, Russian, Order Number DE94626616. Source: OSTI; NTIS (US Sales Only); INIS.

The Director General received notes verbales dated 15 and 22 March 1994 from the Permanent Mission of South Africa providing information on the nuclear export policies and practices of the Government of South Africa. These notes verbales contain, in their attachments, copies of the relevant legislation and other documentation pertaining to South Africa's policy to act in accordance with the provisions of INFCIRC/254/Rev.1/Part 1 and INFCIRC/254/Rev.1/Part 1/Mod.1 and INFCIRC/254/Rev.1/Part 2 as amended. The documents are available on request from the Secretariat of the IAEA.

243 (IAEA-INFCIRC–437) **Communications dated 18 and 19 March 1994 received from the permanent mission of the Democratic People's Republic of Korea to the International Atomic Energy Agency.** International Atomic Energy Agency, Vienna (Austria). 14 Apr 1994. 63p. (In Arabic, Chinese, English, French, Russian, Order Number DE94626617. Source: OSTI; NTIS (US Sales Only); INIS.

Texts of the following communications received from the Permanent Mission of the Democratic People's Republic of Korea, concerning IAEA safeguards inspections, are being circulated to all Member States of the Agency at the Request of the Permanent Mission of the Democratic People's Republic of Korea.

244 (IAEA-INFCIRC–439) **Communique dated 31 March 1994 by the Greek Presidency on behalf of the European Union.** International Atomic Energy Agency, Vienna (Austria). 14 Apr 1994. 12p. (In Arabic, English, Spanish, French, Russian, Order Number DE94626618. Source: OSTI; NTIS (US Sales Only); INIS.

Text of the Communique of 31 March 1994 of the Greek Presidency on behalf of the European Union on the nuclear problem in the Democratic People's Republic of Korea is being brought to the attention of all Member States of the International Atomic Energy Agency at the request of the Charge d'Affaires a.i. of the Permanent Mission of Greece.

245 (IAEA-INFCIRC–448) **The Treaty for the prohibition of nuclear weapons in Latin America and the Caribbean (Tlatelolco Treaty).** International Atomic Energy Agency, Vienna (Austria). 24 Jun 1994. 11p. (In Arabic, Chinese, English, French, Russian, Order Number DE95605209. Source: OSTI; NTIS (US Sales Only); INIS.

In a note verbale of 10 June 1994, the Agency was informed that, on 30 May 1994, the instruments necessary to bring the Treaty for the Prohibition of Nuclear Weapons in Latin American and the Caribbean into force for the Federative Republic of Brazil had been deposited. As requested by the Permanent Mission of Brazil to the International Organizations in Vienna, the text of the note is attached hereto for the information of Member States.

246 (IAEA-INFCIRC–455) **Agreement of 30 September 1993 between the Republic of Armenia and the International Atomic Energy Agency for the application of safeguards in connection with the treaty on the non-proliferation of nuclear weapons.** International Atomic Energy Agency, Vienna (Austria). Sep 1994. 215p. (In Arabic, Chinese, English, French, Russian, Order Number DE95623457. Source: OSTI; NTIS (US Sales Only); INIS.

The text of the Agreement between the Republic of Armenia and the International Atomic Energy Agency for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons is reproduced in this document for the information of all Members. The Agreement was approved by the Agency's Board of Governors on 21 September 1993 and signed in Vienna on 30 September 1993. The Agreement entered into force, pursuant to Article 24, on 5 May 1994.

247 (IAEA-INFCIRC–456) **Agreement of 22 September 1994 between the Republic of Zambia and the International Atomic Energy Agency for the application of safeguards in connection with the treaty on the non-proliferation of nuclear weapons.** International Atomic Energy Agency, Vienna (Austria). Oct 1994. 229p. (In Arabic, Chinese, English, French, Russian, Order Number DE95623458. Source: OSTI; NTIS (US Sales Only); INIS.

The text of the Agreement between the Republic of Zambia and the International Atomic Energy Agency for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons is reproduced in this document for the information of all Members. The Agreement was approved by the Agency's Board of Governors on 8 June 1994 and signed in Vienna on 22 September 1994. The Agreement entered into force, pursuant to Article 24, on 22 September 1994.

248 (IAEA-INFCIRC–461) **Statement, dated 8 December 1994, by the presidency on behalf of the European Union on the accession of Ukraine to the treaty on the non-proliferation of nuclear weapons.** International Atomic Energy Agency, Vienna (Austria). 22 Dec 1994. 12p. (In Arabic, Chinese, English, French, Russian, Order Number DE95623459. Source: OSTI; NTIS (US Sales Only); INIS.

The European Union has published the attached statement, dated 8 December 1994, on the accession of Ukraine to the Treaty on the Non-Proliferation of Nuclear Weapons. The statement is being circulated to all Member States at the request of the Resident Representative of the Federal Republic of Germany on behalf of the European Union.

249 (INIS-mf–13907, pp. 104-107) **Management of transuranics using Integral Fast Reactor fuel cycle.** Wade, D.C. (Argonne National Lab., IL (United States)). Ben-Gurion Univ. of the Negev, Beersheba (Israel). Jan 1994. (CONF-940109–: International conference on reactor physics and reactor compuations, Tel Aviv (Israel), 23-26 Jan 1994). In *Reactor Physics and reactor computations: Proceedings of the international conference on reactor physics and reactor computations.* 814p. Order Number DE94627122. Source: OSTI; NTIS (US Sales Only); INIS.

The 50 years of activities following the discovery of self-sustained fission chains have given rise to a buildup of roughly 900 tonnes of manmade transuranics. The formation of the transuranics is initiated by the parasitic neutron capture on the abundant isotope (U^{238}) of uranium ore to produce Pu^{239} and the minor actinides are formed via the unavoidable parasitic neutron capture on the transuranic isotopes themselves. of the total, 260 tonnes of Pu^{239} were generated for use in weapons while the remainder were generated as a byproduct of electrical power produced worldwide by the commercial thermal nuclear power industry. What to be done with these actinides? The options for disposition include interminable storage, burial, or recycle for use. The pros and cons of each option are being vigorously debated regarding the impact upon the issues of human and ecological risk both current and future; weapon proliferation potential both current and future; and total life cycle benefits and costs. (authors). 1 fig.

250 (INIS-mf–13970) **The disarmament agenda of the international community in 1994 and beyond: Statements of the Secretary-General.** Boutros Ghali, B. United Nations, New York, NY (USA). Apr 1994. 38p. (In English, French). (CONF-940197–: Advisory board on disarmament matters: conference on disarmament, Geneva (Switzerland), 12 Jan 1994). Order Number DE94636724. Source: OSTI; NTIS (US Sales Only); INIS.

The document comprises two statements of the Secretary-General delivered in January 1994, conveys present thinking on possible approaches to be taken in the light of the events of the past year and views on a number of specific tasks that the international community must now carry out with a sense of urgency.

251 (INIS-mf–13970, pp. 2-9) **Address of the Secretary-General to the Advisory Board on disarmament matters.** Boutros Ghali, B. United Nations, New York, NY (USA). Apr 1994. 38p. (In English, French). (CONF-940197–: Advisory board on disarmament matters: conference on disarmament, Geneva (Switzerland), 12 Jan 1994). In *The disarmament agenda of the international community in 1994 and beyond: Statements of the Secretary-General.* Order Number DE94636724. Source: OSTI; NTIS (US Sales Only); INIS.

In his address the Secretary-General discussing the future disarmament agenda, suggested to concentrate on the following crucial questions: what are the key issues? what should be on the disarmament agenda of international community in 1994 and beyond? what new concepts, new approaches, can be used to integrate, globalize, and reinvigorate the debate about disarmament.

252 (INIS-mf–13970, pp. 10-14) **Message of the Secretary-General to the conference on disarmament.** Boutros Ghali, B. United Nations, New York, NY (USA). Apr 1994. 38p. (In English, French). (CONF-940197–: Advisory board on disarmament matters: conference on disarmament, Geneva (Switzerland), 12 Jan 1994). In *The disarmament agenda of the international community in 1994 and beyond:*

Statements of the Secretary-General. Order Number DE94636724. Source: OSTI; NTIS (US Sales Only); INIS.

In his message the Secretary-General stressed the positive trends towards the consolidation of the pattern of cooperation among Members of the United Nations in the vital sphere of security, arms limitation and disarmament, as exemplified by the growing number of resolutions adopted by consensus in this field.

253 (INIS-mf–14433) **Selected legal documents in the field of peaceful uses of nuclear energy in the Czech Republic.** Bezpecnost Jadernych Zarizeni, no.5. Statni Urad pro Jadernou Bezpecnost, Prague (Czech Republic). 1994. 187p. (In Czech). Order Number DE95613296. Source: OSTI; NTIS (US Sales Only); INIS.

English translation available from Nuclear Information Center, 156 16 Prague-Zbraslav, Czech Republic, at USD 10.- per typewritten page.

Reproduced are full texts or parts of selected acts, regulations, decrees and other applicable Czech legal documents dealing with state surveillance over nuclear safety of nuclear facilities and of the environment, construction of nuclear facilities, non-proliferation of nuclear weapons, accountancy of and control over nuclear materials, nuclear safety, radioactive wastes, and ways to ensure safety and security in nuclear power and related industrial sectors. (J.B.).

254 (INIS-mf–14475, pp. 26-39) **Statement to the forty-ninth session of the United Nations General Assembly.** Blix, H. (International Atomic Energy Agency, Vienna (Austria)). International Atomic Energy Agency, Vienna (Austria). Oct 1994. 40p. (CONF-9410326–: 38. session of the General Conference of the International Atomic Energy Agency; 49. session of the United Nations General Assembly, New York, NY (United States), 17 Oct 1994; IAEA-PI–C21E.). In *Statement to the 38th session of the General Conference of the International Atomic Energy Agency 19 September 1994; Statement to the 49th session of the United Nations General Assemblies 17 October 1994.* Order Number DE95625483. Source: OSTI; NTIS (US Sales Only); INIS.

In his statement, the Director General of the IAEA presents the activity of the IAEA in the implementation of safeguards in Iraq, DPRK, the newly independent states of the former Soviet Union, Latin America, Africa and the Middle East, the role of the Agency in the verification of nuclear material from nuclear weapons and in the prevention of the illicit trafficking of nuclear materials. The last part of the statement is devoted to the Agency's activity in the field of nuclear power and non-power nuclear applications.

255 (JEP–004) **Instrumentation and procedures for identifying plutonium at storage facilities for nuclear-weapon components.** Gosnell, T.B. (Lawrence Livermore National Lab., CA (United States)); Rowland, M.S.; Butterfield, K.B.; Marlow, K.W.; Mitchell, D.J. Lawrence Livermore National Lab., CA (United States). May 1994. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Source: OSTI.

A panel of technical experts was tasked by DOE to propose radiation detection equipment and procedures for inspections of plutonium storage facilities in Russia and the US. The panel examined several factors, including the commercial availability of detectors and software, portability and power requirements of the equipment, and ease of operation. Algorithms for processing data, used in conjunction with the recommended detectors, can simply and unambiguously identify the presence of plutonium. The panel's first choice is using a sodium iodide detector to identify plutonium. The panel concluded that gamma-ray spectra recorded with a sodium iodide detector can be analyzed using simple algorithms to unambiguously identify plutonium, but the mass of plutonium cannot be determined within a factor of ten without more sophisticated processing of the data. Because the proposed algorithms can be implemented in an automated fashion, the presence of plutonium can be determined without revealing any additional information regarding the source characteristics. A collimator is essential if measurements are made in facilities with high background-radiation levels because of the presence of other weapon components. In addition to absolutely unambiguous plutonium identification, the mass can be crudelv estimated using a high-purity germanium detector – the panel's second choice – but cryogenic cooling is required. The panel's third choice is augmented neutron detection. Neutron measurements alone are inadequate because other neutron sources cannot be distinguished from plutonium, but the detection of neutrons combined with visual inspection and thermal emission measurements could provide adequate confidence if the Russians are unwilling to accept gamma-ray measurements during inspections.

256 (LA–12723-MS-Vol.1) **Assessment of radiation measurement equipment for use in transparency/ safeguards: Volume 1.** Frankle, C.M.; Close, D.A.; Erkkila, B.H.; Estes, G.P.; Stanbro, W.D. Los Alamos National Lab., NM (United States). Feb 1994. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Source: OSTI.

This report contains an evaluation of radiation measurement equipment which can be used in a transparency or safeguards program associated with nuclear warhead dismantlement and the long-term storage of the plutonium and uranium. All categories of commercially available radiation measurement equipment are reviewed, both prepackaged ready-to-operate instruments that contain all necessary components and custom research-type instruments that require assembly of the necessary components. The measurement capabilities of such instruments and their ability to determine the presence of Pu or HEU is detailed. A few techniques that are not based on detection of the intrinsic gamma-ray and neutron signatures are also discussed. A section comparing a transparency-like program to the typical IAEA safeguards program is also given.

257 (LA–12748-MS) **Explosive performance on the non-proliferation experiment.** McKown, T.O. Los Alamos National Lab., NM (United States). Mar 1994. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94007724. Source: OSTI; NTIS; GPO Dep.

The non-proliferation experiment, originally called the chemical kiloton experiment, was planned and executed by Lawrence Livermore National Laboratory to investigate the seismic yield relationship and distinguishing seismic signals between a nuclear event and a large mass conventional explosion. The Los Alamos National Laboratory planned and conducted experiments to further their studies of the source

function for signals observed seismically. Since all investigations were contingent on the performance of the emplaced chemical explosive, an array of diagnostic measurements was fielded in the emplaced explosive. The CORRTEX system was used to investigate the explosive initiation and to determine the detonation velocities in multiple levels and in numerous directions. A description of the CORRTEX experiments fielded, a review of the data obtained and some interpretations of the data are reported.

258 (LA–12766-MS) **Predicting linear and nonlinear time series with applications in nuclear safeguards and nonproliferation.** Burr, T.L. Los Alamos National Lab., NM (United States). Apr 1994. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94010215. Source: OSTI; NTIS; INIS; GPO Dep.

This report is a primer on the analysis of both linear and nonlinear time series with applications in nuclear safeguards and nonproliferation. We analyze eight simulated and two real time series using both linear and nonlinear modeling techniques. The theoretical treatment is brief but references to pertinent theory are provided. Forecasting is our main goal. However, because our most common approach is to fit models to the data, we also emphasize checking model adequacy by analyzing forecast errors for serial correlation or nonconstant variance.

259 (LA–12774-MS) **The use of curium neutrons to verify plutonium in spent fuel and reprocessing wastes.** Miura, N. (Tokai Reprocessing Plant, Tokai-mura, Ibaraki (Japan). Tokai Works); Menlove, H.O. Los Alamos National Lab., NM (United States). May 1994. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013646. Source: OSTI; NTIS; INIS; GPO Dep.

For safeguards verification of spent fuel, leached hulls, and reprocessing wastes, it is necessary to determine the plutonium content in these items. We have evaluated the use of passive neutron multiplicity counting to determine the plutonium content directly and also to measure the $^{240}Pu/^{244}Cm$ ratio for the indirect verification of the plutonium. Neutron multiplicity counting of the singles, doubles, and triples neutrons has been evaluated for measuring ^{240}Pu, ^{244}Cm, and ^{252}Cf. We have proposed a method to establish the plutonium to curium ratio using the hybrid k-edge densitometer x-ray fluorescence instrument plus a neutron coincidence counter for the reprocessing dissolver solution. This report presents the concepts, experimental results, and error estimates for typical spent fuel applications.

260 (LA–12775-MS) **Some NUDET effects due to water containment.** Symbalisty, E.M.D. Los Alamos National Lab., NM (United States). Jul 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94015178. Source: OSTI; NTIS; GPO Dep.

The effect on the optical and acoustical signals of containing a nominal low yield nuclear device in a sphere of water is studied. The silicon photodiode optical signal is seen to be distorted by a relatively small amount of water. The acoustical signal timing and shape change little.

261 (LA–12869-MS) **Influence of the hysteretic phase change in granite on seismic and hydrodynamic coupling of nuclear explosions.** Bos, R.J.; Dey, T.N.; Boettger, J.C. Los Alamos National Lab., NM (United States). Dec 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE95006102. Source: OSTI; NTIS; GPO Dep.

Using Boettger's new two-phase treatment of hysteretic phase changes, calculations were done to observe the effect of the silicate phase change in the hydrodynamic region and seismic region of an underground nuclear explosion. The results indicate a small effect on shock time of arrival, a moderate effect on peak particle velocities, peak pressures in the hydrodynamic region, and negligible effect on seismic signals in the seismic region.

262 (LA-SUB–94-153) **Future directions for arms control and nonproliferation: Conference summary.** Los Alamos National Lab., NM (United States); Science Applications International Corp., San Diego, CA (United States). 6 Jul 1994. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE95001753. Source: OSTI; NTIS; GPO Dep.

This report provides a summary of the presentations and discussions at the Spring 1994 CNSN-Wilton Park Conference. The Conference was one of a series on US-European security cooperation organized by The Center for National Security Negotiations (CNSN) of Science Applications International Corporation. These conferences bring together government and non-government experts, primarily from the United States and Europe, to discuss a range of regional and global security issues. The conferences provide an opportunity to explore, in a frank and off-the-record environment, common interests and concerns, as well as differences in approach that affect trans-Atlantic cooperation. This report is divided into the following three areas: (1) implementation of existing and pending agreements; (2) non-proliferation: prospects for trans-Atlantic cooperation; and (3) future directions in arms control.

263 (LA-UR–94-154) **Sensitive field alpha contamination monitoring for special inspections and nonproliferation verification.** MacArthur, D.W.; Allander, K.S.; Bounds, J.A.; Close, D.A.; Johnson, J.D. Los Alamos National Lab., NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (IAEA-SM–333/126; CONF-940307–17: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994). Order Number DE94006273. Source: OSTI; NTIS; GPO Dep.

Alpha-contamination monitoring in the field has traditionally been limited by the short range of alpha particles in air, the relative insensitivity of alpha monitors designed for field use, and the difficulty of operating laboratory instruments in the field. The long-range alpha detector (LRAD) described in this paper circumvents these limitations by detecting air ions produced by alpha particles rather than the particles themselves. The LRAD system comes in two configurations: one utilizes forced air to bring the ions to the detector, the other uses an electric field. We have developed successful hand-carried versions of both detectors and operated them under field conditions. The unique characteristics of LRAD systems enlarge the number of potential applications for alpha monitors in the field.

264 (LA-UR–94-164) **Advances in passive neutron instruments for safeguards use.** Menlove, H.O.; Krick,

M.S.; Langner, D.G.; Miller, M.C.; Stewart, J.E. Los Alamos National Lab., NM (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (IAEA-SM–333/94; CONF-940307–16: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994). Order Number DE94006271. Source: OSTI; NTIS; INIS; GPO Dep.

Passive neutron and other nondestructive assay techniques have been used extensively by the International Atomic Energy Agency to verify plutonium metal, powder, mixed oxide, pellets, rods, assemblies, scrap, and liquids. Normally, the coincidence counting rate is used to measure the ^{240}Pu-effective mass and gamma-ray spectrometry or mass spectrometry is used to verify the plutonium isotopic ratios. During the past few years, the passive neutron detectors have been installed in plants and operated in the unattended/continuous mode. These radiation data with time continuity have made it possible to use the totals counting rate to monitor the movement of nuclear material. Monte Carlo computer codes have been used to optimize the detector designs for specific applications. The inventory sample counter (INVS-III) has been designed to have a higher efficiency (43%) and a larger uniform counting volume than the original INVS. Data analyses techniques have been developed, including the "known alpha" and "known multiplication" methods that depend on the sample. For scrap and other impure or poorly characterized samples, we have developed multiplicity counting, initially implemented in the plutonium scrap multiplicity counter. For large waste containers such as 200-L drums, we have developed the add-a-source technique to give accurate corrections for the waste-matrix materials. This paper summarizes recent developments in the design and application of passive neutron assay systems.

265 (LA-UR–94-0184) **Policy and technical issues for international safeguards in nuclear weapons states.** Markin, J.T.; Stanbro, W.D. Los Alamos National Lab., NM (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940307–9: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994). Order Number DE94006265. Source: OSTI; NTIS; INIS; GPO Dep.

Expansion of international safeguards into the military and commercial fuel cycles of the nuclear weapons states (NWS) – the subject of previous proposals in international safeguards discussions and of studies in the safeguards literature – has been given impetus by recent US government initiatives for safeguards on excess weapons materials and a verified fissile materials production cutoff. These proposals, if implemented, would have implications on the safeguards objectives, approaches, and technologies that are traditionally employed in international safeguards. This paper examines the modifications and innovations that might be required to the current international safeguards regime in meeting these proposed new roles. Although the examples given are in the context of the US materials and facilities, many of the conclusions are valid for other NWS. None of the statements in this paper represent official US position on policy for international safeguards in weapons states. Instead, the purpose is to identify policy and technical issues and to offer, where possible, options for their resolution. This paper limits consideration to the potential role of the IAEA in verifying these proposed initiatives for declared facilities, recognizing that there may also be a role for bilateral, multilateral, or regional verification regimes. Indeed, in some cases verification of weapons materials may be more appropriate for a bilateral arrangement. Because traditional IAEA safeguards may not be admissible for weapons materials, the concept of "transparency" is suggested as a less intrusive alternative providing some confidence that materials are as declared

266 (LA-UR–94-0256) **Continuous remote unattended monitoring for safeguards data collection systems.** Klosterbuer, S.F.; Halbig, J.K.; Harker, W.C.; Menlove, H.O.; Painter, J.A.; Stewart, J.E. Los Alamos National Lab., NM (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (IAEA-SM–333/111; CONF-940307–15: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994). Order Number DE94006242. Source: OSTI; NTIS; INIS; GPO Dep.

To meet increased inspection requirements, unattended and remote monitoring systems have been developed and installed in several large facilities to perform safeguards functions. These unattended monitoring systems are based on instruments originally developed for traditional safeguards and the domestic nuclear industry to nondestructively assay nuclear materials. Through specialized measurement procedures, these instruments have been adapted to be unattended monitors. This paper defines the parts of these unattended monitoring systems, describes the systems that have been installed in the field and their status, and discusses future trends for unattended systems.

267 (LA-UR–94-400) **The use of the long-range alpha detector (LRAD) for alpha emission surveys at active and inactive firing sites.** Mason, C.F.V. (Los Alamos National Lab., NM (United States)); Allander, K.S.; Bounds, J.A.; Garner, S.E.; Walter, K.J. Los Alamos National Lab., NM (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940225–47: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94007526. Source: OSTI; NTIS; INIS; GPO Dep.

Surveys were carried out at five different firing sites at Los Alamos National Laboratory to measure residual alpha emissions in earth contaminated with natural and depleted uranium. This contamination is caused by controlled experimental explosions during testing of the non fissile components of nuclear weapons. Two conclusions were reached: the first is that post shot clearing of the experimental areas is effective at removing contamination and the second is that the diminution of alpha emissions due to aging is small.

268 (LA-UR–94-988) **EMP from a chemical explosion originating in a tunnel.** Kelly, B. Los Alamos National Lab., NM (United States). Mar 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404132–1: Non-proliferation experiment (NPE), Washington, DC (United States), 19-21 Apr 1994). Order Number DE94009340. Source: OSTI; NTIS; GPO Dep.

Electromagnetic pulses generated by a chemical explosion deep in a tunnel have been detected by sensors placed on both sides of the portal. These detectors consisted of antennas, current transformers, B-dots, and D-dots. The main

objective was to collect data for nonproliferation studies complementary to and in cooperation with seismic methods. The electric field strength at the portal was computed from the data to be on the order of 50 millivolts per meter, with a Fourier transform indicating that most of the energy occurs below about 3 MHz. Several of the sensors displayed periodic sharp spikes probably not related to the device. Surface guided waves were detected along power and ground cables plus the railroad track. Time dependent surface current and charge were measured on the portal door, which serves as a secondary source for external radiation.

269 (LA-UR-94-1032) **Explosive-array performance measurement using TDR.** McKown, T.O. (Los Alamos National Lab., NM (United States)); Eilers, D.D. Los Alamos National Lab., NM (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940986–1: Time domain reflectometry in environmental, infrastructure and mining applications symposium, Evanston, IL (United States), 6-7 Sep 1994). Order Number DE94009338. Source: OSTI; NTIS; GPO Dep.

The system known as CORRTEX was developed for determining the yield of a nuclear explosion by measuring the position of its shock front as a function of time. The CORRTEX system is a compact, fast sampling TDR based system where only a length of 50 ohm coaxial cable (the sensing element) is expended in the detonation. In 1979, the application of the CORRTEX system to measure the explosive burn of columns of conventional explosive in one or more drill holes was demonstrated. Subsequently, the CORRTEX system was used to diagnose complicated multiple hole high explosive oilshale, rock quarry and strip mining shots. The diagnostic timing and explosive characterization data from large array or large mass detonations provide a basis for performance improvement and comparison with calculational models. A summary of the CORRTEX capabilities and analysis techniques will be presented. Experiment designs and data from large array detonations will be presented, results from a confined large mass ANFO explosion will be summarized and other possible non-explosive applications may be presented.

270 (LA-UR-94-1077) **Video imaging for Nuclear Safeguards.** Bradley, J.N.; Brislawn, C.M.; Brown, J.E.; Rodriguez, C.A.; Stoltz, L.A. Los Alamos National Lab., NM (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9403105–1: Industrial data compression workshop and conference, Snow Bird, UT (United States), 30 Mar - 1 apr 1994). Order Number DE94009330. Source: OSTI; NTIS; GPO Dep.

The field of Nuclear Safeguards has received increasing amounts of public attention since the events of the Iraq-UN conflict over Kuwait, the dismantlement of the former Soviet Union, and more recently, the North Korean resistance to nuclear facility inspections by the International Atomic Energy Agency (IAEA). The role of nuclear safeguards in these and other events relating to the world's nuclear material inventory is to assure safekeeping of these materials and to verify the inventory and usage of these materials as reported by states that have signed the Nuclear Nonproliferation Treaty. Nuclear Safeguards are measures prescribed by domestic and international regulatory bodies and implemented by the nuclear facility or the regulatory body. These measures include destructive and nondestructive analysis of product materials and process by-products for materials control and accountancy purposes, physical protection for domestic safeguards, and containment and surveillance for international safeguards. In this presentation we will introduce digital video image processing and analysis systems that have been developed at Los Alamos National Laboratory for application to the nuclear safeguards problem. Of specific interest to this audience is the detector-activated predictive wavelet transform image coding used to reduce drastically the data storage requirements for these unattended, remote safeguards systems.

271 (LA-UR-94-1126) **Induced shock propagation on the Non-Proliferation Experiment.** McKown, T.O. Los Alamos National Lab., NM (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404100–1: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94009320. Source: OSTI; NTIS; INIS; GPO Dep.

The Explosive Effects Physics Project at the Los Alamos National Laboratory planned and conducted experiments on the NPE (Non-Proliferation Experiment) as part of its effort to define source functions for seismic waves. Beyond the explosive chamber, the detonation induced shock propagated through the saturated tuff of the N-tunnel complex. The CORRTEX (COntinuous Reflectometry for Radius vsw Time EXperiment) system was used to investigate the shock propagation in two drill holes and the access drift. The CORRTEX experiments fielded will be described. The data obtained are reviewed and an apparent asymmetry in the radiating shock is discussed.

272 (LA-UR-94-1191) **Axisymmetric magnetic gauges.** Wright, B.L.; Alrick, K.R.; Fritz, J.N. Los Alamos National Lab., NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404100–2: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94011655. Source: OSTI; NTIS; GPO Dep.

Axisymmetric magnetic (ASM) gauges are useful diagnostic tools in the study of the conversion of energy from underground explosions to distant seismic signals. Requiring no external power, they measure the strength (particle velocity) of the emerging shock wave under conditions that would destroy most instrumentation. Shock pins are included with each gauge to determine the angle of the shock front. For the Non-Proliferation Experiment, two ASM gauges were installed in the ANFO mixture to monitor the detonation wave and 10 were grouted into boreholes at various ranges in the surrounding rock (10 to 64 m from the center of explosion). These gauges were of a standard 3.8-inch-diameter design. In addition, two unique Jumbo ASM gauges (3-ft by 3-ft in cross section) were grouted to the wall of a drift at a range of 65 m. We discuss issues encountered in data analysis, present the results of our measurements, and compare these results with those of model simulations of the experiment.

273 (LA-UR–94-1224) **Ionospheric measurements for the Non-Proliferation Experiment.** Fitzgerald, T.J. Los Alamos National Lab., NM (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404100–3: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94011659. Source: OSTI; NTIS; INIS; GPO Dep.

The detection of explosions using ionospheric techniques relies on measuring perturbations induced in radio propagation by acoustics waves which disturb the electron density of the ionosphere. Such techniques have been applied to the detection of atmospheric explosions, underground nuclear tests, earthquakes, and surface mining explosions. The nighttime ionosphere presents a difficulty for the detection of explosions because in the absence of solar ionization radiation the electron density in the altitude range of 90 to 200 km decays after sunset and perturbation effects are correspondingly reduced. On the other hand, acoustic waves produced by weak sources reach a maximum amplitude in the altitude range of 100 to 150 km and are highly attenuated at altitudes above 200 km. For safety reasons, most planned explosions are conducted during daylight which has limited the experimental measurements during nighttime. However a recent opportunity for a nighttime measurement occurred in connection with the Non-Proliferation Experiment which consisted of the detonation of a large chemical charge underground at the Nevada Test Site near midnight local time. the results, based on a new technique of using medium frequency radio transmissions provided by commercial broadcasts to detect explosion effects, were negative. The most likely explanation for the negative result is that the radio transmissions did not reflect at a low enough altitude to sense the perturbations produced by the acoustic waves.

274 (LA-UR–94-1430) **Weapons and commercial plutonium ultimate disposition choices: Destroy "completely" or store forever.** Bowman, C.D. Los Alamos National Lab., NM (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940180–2: Managing the plutonium surplus: applications and options conference, London (United Kingdom), 24-25 Jan 1994). Order Number DE94014720. Source: OSTI; NTIS; GPO Dep.

All of the options under consideration for weapons and commercial plutonium disposition ultimately boil down to the choices of either "complete" destruction or storage "forever." None of the reactor-based plutonium burning systems demonstrated over the past 50 years of reactor development consume this material completely. Ultimately considerable unburned plutonium must be stored "forever" from those systems. Plutonium is considered to be dangerous both as a weapons material and as a health hazard. While properly stored plutonium might never make its way back by natural phenomena into the environment as a health hazard, stored plutonium is always accessible to recovery for malevolent purposes. It must be guarded wherever in the world it is stored for as long as it continues to exist. Complete destruction of the plutonium eliminates this material as a concern of future generations. Los Alamos National Laboratory accelerator-driven technology promises to allow safe and complete destruction of this material. Furthermore it appears that in the process of destruction the neutron rich features of the weapons plutonium provides benefits to society that place a value on weapons plutonium exceeding that of highly enriched uranium. A realistic time scale for development and deployment of burial technology either with or without partial burning in reactors is expected to be comparable with or to exceed the time for development and deployment of the accelerator-driven destruction method under study at Los Alamos.

275 (LA-UR–94-1538) **User manual for the NTS ground motion data base retrieval program: ntsgm.** App, F.N. (Los Alamos National Lab., NM (United States). Earth and Environmental Sciences Div.); Tunnell, T.W. Los Alamos National Lab., NM (United States). May 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94012886. Source: OSTI; NTIS; GPO Dep.

The NTS (Nevada Test Site) Ground Motion Data Base is composed of strong motion data recorded during the normal execution of the US underground test program. It contains surface, subsurface, and structure motion data as digitized waveforms. Currently the data base contains information from 148 underground explosions. This represents about 4,200 measurements and nearly 12,000 individual digitized waveforms. Most of the data was acquired by Los Alamos National Laboratory (LANL) in connection with LANL sponsored underground tests. Some was acquired by Los Alamos on tests conducted by the Defense Nuclear Agency (DNA) and Lawrence Livermore National Laboratory (LLNL), and there are some measurements that were acquired by the other test sponsors on their events and provided for inclusion in this data base. Data acquisition, creation of the data base, and development of the data base retrieval program (ntsgm) are the result of work in support of the Los Alamos Field Test Office and the Office of Nonproliferation and Arms Control.

276 (LA-UR–94-1557) **The NTS Ground Motion Data Base.** App, F.N. Los Alamos National Lab., NM (United States). Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404100–5: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94012911. Source: OSTI; NTIS; GPO Dep.

The NTS (Nevada Test Site) Ground Motion Data Base is composed of strong motion data recorded during the normal execution of the US underground test program. It contains surface, subsurface, and structure motion data as digitized waveforms. Currently the data base contains information from 148 underground explosions This represents about 4200 measurements and nearly 12,000 individual digitized waveforms. Most of the data was acquired by Los Alamos National Laboratory (LANL) in connection with LANL sponsored underground tests. Some was acquired by Los Alamos on tests conducted by the Defense Nuclear Agency (DNA) and Lawrence Livermore National Laboratory (LLNL), and there are some measurements which were acquired by the other test sponsors on their events and provided to us for inclusion in this data base. Included in the data set is the Los Alamos motion data from the Non-Proliferation Experiment (NPE).

277 (LA-UR–94-1650) **A maximum-likelihood reconstruction algorithm for tomographic gamma-ray**

nondestructive assay. Prettyman, T.H.; Estep, R.J.; Cole, R.A.; Sheppard, G.A. Los Alamos National Lab., NM (United States). [1994]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940524–6: 8. symposium on radiation measurements and applications, Ann Arbor, MI (United States), 16-19 May 1994). Order Number DE94012909. Source: OSTI; NTIS; INIS; GPO Dep.

A new tomographic reconstruction algorithm for nondestructive assay with high resolution gamma-ray spectroscopy (HRGS) is presented. The reconstruction problem is formulated using a maximum-likelihood approach in which the statistical structure of both the gross and continuum measurements used to determine the full-energy response in HRGS is precisely modeled. An accelerated expectation-maximization algorithm is used to determine the optimal solution. The algorithm is applied to safeguards and environmental assays of large samples (for example, 55-gal. drums) in which high continuum levels caused by Compton scattering are routinely encountered. Details of the implementation of the algorithm and a comparative study of the algorithm's performance are presented.

278 (LA-UR–94-1779) **Design advances in long-range alpha detection.** Johnson, J.P.; Allander, K.S.; Arnone, G.; Bolton, R.D.; Garner, S.E.; MacArthur, D.W.; Sprouse, L.L.; Walters, S.G. Los Alamos National Lab., NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940815–10: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94012901. Source: OSTI; NTIS; GPO Dep.

Recent design advances in airflow long-range alpha detector (LRAD) technology have improved the detectors' sensitivity, reduced their size and weight, and reduced their construction costs. These second-generation LRADs are also less influenced by fluctuations in background radiation. These advances now allow airflow LRAD systems to be lightweight, low-power, and portable, thereby increasing their usefulness to the radiation monitoring industry.

279 (LA-UR–94-1813) **Free-field ground motions for the nonproliferation experiment: Preliminary comparisons with nearby nuclear events.** Olsen, K.H.; Peratt, A.L. Los Alamos National Lab., NM (United States). [1994]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404100–4: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94013131. Source: OSTI; NTIS; INIS; GPO Dep.

Since 1987, we have installed fixed arrays of tri-axial accelerometers in the fire-field near the shot horizons for low-yield ($\leq$ 20 kt) nuclear events in the N-tunnel complex beneath Rainier Mesa. For the Nonproliferation Experiment (NPE) we augmented the array to achieve 23 free-field stations. Goals are: (a) to examine robustness and stability of various free-field source function estimates – e.g., reduced displacement potentials (RDP) and spectra; (b) to compare close-in with regional estimates to test whether detailed close-in free-field and/or surface ground motion data can improve predictability of regional-teleseismic source functions; (c) to provide experimental data for checking two-dimensional numerical simulations. We report preliminary comparisons between experimental free-field data for NPE (1993) and three nearby nuclear events (MISTY ECHO, 1988; MINERAL QUARRY, 1990; HUNTERS TROPHY, 1992). All four working points are within 1 km of each other in the same wet tuff bed, thus reducing concerns about possible large differences in material properties between widely separated shots. Initial comparison of acceleration and velocity seismograms for the four events reveals: (1) There is a large departure from the spherical symmetry commonly assumed in analytic treatments of source theory; both vertical and tangential components are surprisingly large. (2) All shots show similar first-peak particle-velocity amplitude decay rates suggesting significant attenuation even in the supposedly purely elastic region. (3) Sharp (>20 Hz) arrivals are not observed at tunnel level from near-surface pP reflections or spall-closure sources – but broadened peaks are seen that suggest more diffuse reflected energy from the surface and from the Paleozoic limestone basement below tunnel level.

280 (LA-UR–94-1888) **Stochastic source comparisons between nuclear and chemical explosions detonated at Rainier Mesa, Nevada Test Site.** Stump, B.W. (Los Alamos National Lab., NM (United States). Geophysics Group); Pearson, D.C.; Reinke, R.E. Los Alamos National Lab., NM (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. F19628-89-k-0025k. (CONF-9404100–9: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94014454. Source: OSTI; NTIS; GPO Dep.

The focus of this study is the understanding of the time function effects for chemical and nuclear explosion sources detonated in a spherical geometry. Information developed here in combination with similar studies for earthquakes and mining explosions will be used to improve current discriminants, address the transportability of the discriminants to new regions and suggest new discriminants utilizing current data sources. The quantification of the seismic source time function for nuclear and chemical explosions provides the basis for identifying source differences that may develop as a function of yield as well as explosive type (chemical or nuclear). The yield effects are useful in yield determination as well as assessing detection and identification capabilities if seismic monitoring of such sources is important. Source effects attributable to yield can be used to establish new or verify existing scaling relations.

281 (LA-UR–94-1946) **Alpha detection as a probe for counter proliferation.** Koster, J.E.; Johnson, J.P.; MacArthur, D.W.; Walters, S.G. Los Alamos National Lab., NM (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9410105–6: Institute of Electrical and Electronics Engineers international Carnahan conference on security technology, Albuquerque, NM (United States), 12-14 Oct 1994). Order Number DE94014435. Source: OSTI; NTIS; GPO Dep.

An indication of the presence of special nuclear material (SNM) can be obtained by the detection of alpha particles

from the decay of the SNM. Current techniques for detecting alpha particles have a number of limitations. Sensitive conventional detection of SNM traces involves off-site laboratory analysis – but at the loss of an on-site confirmation. Fieldable detection instruments, on the other hand, are delicate and have poor sensitivity. New long-range alpha detection (LRAD) technology mitigates these limitations. An LRAD-based instrument relies on the detection of the hundreds of thousands of ions produced in ambient air by one emitted alpha particle. The ions can be transported to an ion detector at a distance much greater than the range of the original alpha particle. The LRAD-based monitors have the characteristics of high sensitivity, fast (real-time) response, ruggedness, and reliability. Many of the designs are quite portable. In this paper, several scenarios are identified for which particular LRAD-based detectors can provide confirmation of proliferation activity.

282 (LA-UR–94-2081) **Weapons dismantlement issues in independent Ukraine.** Zack, N.R. (Los Alamos National Lab., NM (United States)); Kirk, E.J. Los Alamos National Lab., NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940748–2: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94014469. Source: OSTI; NTIS; GPO Dep.

The American Association for the Advancement of Science sponsored a seminar during September 1993, in Kiev, Ukraine, entitled "Toward a Nuclear Free Future – Barriers and Problems." It brought together Ukrainians, Belarusians, and Americans to discuss the legal, political, safeguards and security, economic, and technical dimensions of nuclear weapons dismantlement and destruction. US representatives initiated discussions on legal and treaty requirements and constraints, safeguards and security issues surrounding dismantlement, storage and disposition of nuclear materials, warhead transportation, and economic considerations. Ukrainians gave presentations on arguments for and against the Ukraine keeping nuclear weapons, Ukrainian Parliament non-approval of START I, alternative strategies for dismantling silos and launchers, and economic and security implications of nuclear weapons removal from the Ukraine. Participants from Belarus discussed proliferation and control regime issues, This paper will highlight and detail the issues, concerns, and possible impacts of the Ukraine's dismantlement of its nuclear weapons.

283 (LA-UR–94-2236) **Design considerations for third party inspection activities for storage facilities.** Metzler, J.F. (USDOE, Washington, DC (United States). Office of Military Applications and Stockpile Support); Zack, N.R.; Hunteman, W.J.; Jaeger, C.D. Los Alamos National Lab., NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36 ; AC04-94AL85000. (SAND–94-0572C; CONF-940748–4: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94014480. Source: OSTI; NTIS; GPO Dep.

Initiatives by the President and the Secretary of available national excess special nuclear for third party inspection and verification required special design requirements to be considered for the reconfigured weapons complex storage facilities. The approach that will be taken in the design and operation will permit controlled access to all nuclear materials and related information that would not disclose or lead to disclosure of classified or proprietary information not obligated by treaty or other agreements. This approach would provide the third party inspectors with the information and capability to access designated materials while minimizing impact upon facility operations. These considerations would also give the federal government the flexibility to add new materials to the excess materials category list in the future. This paper will discuss the safeguards and security design impacts and features that are being anticipated for the storage facilities, both for possible new construction and upgrading existing facilities.

284 (LA-UR–94-2381) **Integration of video and radiation analysis data.** Menlove, H.O. (Los Alamos National Lab., NM (United States)); Howell, J.A.; Rodriguez, C.A.; Eccleston, G.W.; Beddingfield, D.; Smith, J.E.; Baumgart, C.W. Los Alamos National Lab., NM (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940748–61: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94016282. Source: OSTI; NTIS; GPO Dep.

We have introduced a new method to integrate spatial (digital video) and time (radiation monitoring) information. This technology is based on pattern recognition by neural networks, provides significant capability to analyze complex data, and has the ability to learn and adapt to changing situations. This technique could significantly reduce the frequency of inspection visits to key facilities without a loss of safeguards effectiveness.

285 (LA-UR–94-2453) **Development of an integrated, unattended assay system for LWR-MOX fuel pellet trays.** Stewart, J.E. (and others); Hatcher, C.R.; Pollat, L.L. Los Alamos National Lab., NM (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940748–37: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94016156. Source: OSTI; NTIS; INIS; GPO Dep.

Four identical unattended plutonium assay systems have been developed for use at the new light-water-reactor mixed oxide (LWR-MOX) fuel fabrication facility at Hanau, Germany. The systems provide quantitative plutonium verification for all MOX pellet trays entering or leaving a large, intermediate store. Pellet-tray transport and storage systems are highly automated. Data from the "I-Point" (information point) assay systems will be shared by the Euratom and International Atomic Energy Agency (IAEA) Inspectorates. The I-Point system integrates, for the first time, passive neutron coincidence counting (NCC) with electro-mechanical sensing (EMS) in unattended mode. Also, provisions have been made for adding high-resolution gamma spectroscopy. The system accumulates data for every tray entering or leaving the store between inspector visits. During an inspection, data are analyzed and compared with operator declarations for the previous inspection period, nominally one month. Specification of the I-point system resulted from a collaboration between the IAEA, Euratom, Siemens, and

Los Alamos. Hardware was developed by Siemens and Los Alamos through a bilateral agreement between the German Federal Ministry of Research and Technology (BMFT) and the US DOE. Siemens also provided the EMS subsystem, including software. Through the USSupport Program to the IAEA, Los Alamos developed the NCC software (NCC COLLECT) and also the software for merging and reviewing the EMS and NCC data (MERGE/REVIEW). This paper describes the overall I-Point system, but emphasizes the NCC subsystem, along with the NCC COLLECT and MERGE/REVIEW codes. We also summarize comprehensive testing results that define the quality of assay performance.

286 (LA-UR-94-2581) **String-survey results from the CHECKPRO exercise.** Wright, B.L. Los Alamos National Lab., NM (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94016202. Source: OSTI; NTIS; GPO Dep.

Exercise CHECKPRO was conducted by the Arms Control and Nonproliferation Division at DOE/NVOO to evaluate procedures related to verification of the Threshold Test Ban Treaty. It took place at the Edgar Mine, operated by the Colorado School of Mines, from June 1 through June 19, 1994. One of the procedures being considered was a method for determining the coordinates of installed hydrodynamic sensor cables without the use of conventional surveying equipment. A test of this method was made for a cable installation similar to the one proposed for the Russian PRILIV event. Though the accuracy obtained, about 4 mm, was more than adequate for verification purposes, the man-hour requirements of the method make its use questionable for likely fielding scenarios.

287 (LA-UR-94-2738) **Utilization of near-source video and ground motion in the assessment of seismic source functions from mining explosions.** Anderson, D.P. (Southern Methodist Univ., Dallas, TX (United States). Dept. of Geological Sciences); Stump, B.W. Los Alamos National Lab., NM (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9409197-1: 16. annual seismic research symposium, Thornwood, NY (United States), 7-9 Sep 1994). Order Number DE94018263. Source: OSTI; NTIS; GPO Dep.

Identification of seismic events detected under a Comprehensive Test Ban Treaty requires a clear physical understanding of the different types of seismic sources including mining explosions, rock bursts, mine collapse and small, shallow earthquakes. Constraint of the operative physical processes in the source region and linkage to the generation of seismic waveforms with particular emphasis on regional seismograms is needed. In order to properly address the multi-dimensional aspect of data sets designed to constrain these sources, we are investigating a number of modern visualization tools that have only recently become available with new, high-speed graphical computers that can utilize relatively large data sets. The results of this study will provide a basis for identifying important processes in the source region that contribute to regional seismograms.

288 (LA-UR-94-2771) **Infrasonic observations and modeling of the Minor Uncle High Explosive event.** Whitaker, R.; Noel, S.D.; Meadows, W.R. Los Alamos National Lab., NM (United States). [1994]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9406244-1: 6. international symposium on long range sound propagation, Ottawa (Canada), 12-14 Jun 1994). Order Number DE94018093. Source: OSTI; NTIS; GPO Dep.

Minor Uncle was a Department of Defense sponsored explosive test of 2440 tons of ammonium nitrate and fuel oil (ANFO) executed on June 10, 1993, at White Sands Missile Range, NM. Los Alamos National Laboratory made infrasonic observations of this event at three stations: Los Alamos, NM, 250 km range; St. George, UT, 750 km range; and the Nevada Test Site, NV, 928 km range. All three stations obtained positive results and had very low background noise levels. Data from all stations will be presented, and normal mode calculations of the wave propagation, including upper atmospheric winds, to St. George will be compared to the data.

289 (LA-UR-94-3479) **Challenges for mining explosion identification under a Comprehensive Test Ban Treaty: Quantification of the problem and discussion of synergetic solutions.** Stump, B.W. Los Alamos National Lab., NM (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9409244-1: ARPA monitoring technologies conference, San Diego, CA (United States), 26-29 Sep 1994). Order Number DE95002714. Source: OSTI; NTIS; GPO Dep.

Seismic networks provide the primary technology for monitoring compliance with a comprehensive test ban treaty. The design goal of the network is the identification of possibly clandestine explosions detonated below the earth's surface and possible in the oceans. Complementary technologies such as infrasonic, hydroacoustic and radionuclide monitoring supplement the seismic monitoring covering explosions in the atmosphere and oceans. This paper will focus on the problems or ambiguities that can arise in the identification process for chemical explosions. Key questions addressed include: How many mining explosions produce seismograms at regional distances that will have to be detected, located and ultimately identified by the National Data Center? What are the waveform characteristics of these particular mining explosions? Can discrimination techniques based on empirical studies be placed on a firm physical basis so that they can be applied to other regions where we have little monitoring experience? With this information, can evasion capabilities be assessed in a region? Can large scale chemical explosions be used to calibrate source and propagation path effects to regional stations? Can source depth of burial and decoupling effects be studied in such a controlled environment?

290 (LA-UR-94-3871) **A review of broadband regional discrimination studies of NTS explosions and western US earthquakes.** Taylor, S.R. Los Alamos National Lab., NM (United States). [1994]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-950151-1: NATO (ASI)/monitoring a comprehensive test ban treaty, Algrave (Portugal), 23 Jan - 2 feb 1995). Order Number DE95003699. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Verification of a Comprehensive Test Ban Treaty (CTBT) will require the use of regional-distance seismic stations. One important aspect of regional seismic monitoring involves the discrimination of nuclear explosions from other sources such as earthquakes and mining events (e.g. industrial explosions and rockbursts). In this paper, we review earthquake/nuclear explosion discrimination studies in the western US using broad-band seismic data. These studies are important because they are the only ones involving nuclear explosions and other sources in a single geophysical region having excellent ground truth information and a substantial historic database. Additionally, because of access to information from the NTS, much can be learned about the physical basis of regional discriminants. Using multivariate discrimination techniques, it was found, that approximately 96 % of the events analyzed could be correctly identified down to about magnitude 3.5. Most of the events misidentified were recorded with poor signal-to-noise ratio at only a minimal number of stations. However, a few well-recorded events were misclassified for one or more discriminants. Examples of detailed analysis of a missed violation (nuclear explosion that looks like an earthquake) and a false alarm (naturally occurring event that looks like an explosion) are illustrated. Resolution of anomalous events such as these will be critical to CTBT monitoring.

291 (LBL–36008) **Programs that support nonproliferation and defense conversion funded by the US Government.** Rutkowski, H.L. Lawrence Berkeley Lab., CA (United States). Aug 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9408173–1: 19. session of the international seminars on planetary emergencies, Erice (Italy), 19-24 Aug 1994). Order Number DE95000792. Source: OSTI; NTIS; INIS; GPO Dep.

The proliferation of nuclear, chemical, and biological weapons is a serious problem for international security. Consequently the U.S. government has established an array of programs to fund activities that will inhibit this activity. The problem of proliferation and defense conversion, in general, is quite complicated. The most immediate concern is the actual diversion of weapons materials. In the long term; however, weapons of mass destruction must be destroyed in a safe and environmentally sound manner. Ultimately the solution of the proliferation problem lies in the redirection of the intellectual skills of weapons scientists and engineers to peaceful commercial activities. At the present time the economic conditions in the New Independent States create severe pressure on people with critical weapons knowledge to sell their skills to political entities that are dangerous. There are four programs to be discussed in this paper. The first is the "Nunn-Lugar" program which is the largest and is administered by the Department of Defense. Between FY92 and FY94 Congress authorized $1.2B for this activity which is aimed at weapons destruction, storage, and safeguards. The second is the International Science and Technology Center in Moscow and the Science Center about to open in Ukraine. These are joint efforts involving the U.S., the European Community, and Japan to fund projects to prevent proliferation and foster commercial technological activity in Russia, Georgia, and Ukraine. The New Independent States - Industrial Partnering Program is a $35M (FY94) program jointly administered by the Department of Energy and the Department of State.

292 (NEDO–32361) **Study of plutonium disposition using existing GE advanced Boiling Water Reactors.** General Electric Co., San Jose, CA (United States). 1 Jun 1994. 581p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-93SF19681. Order Number DE94013217. Source: OSTI; NTIS; INIS; GPO Dep.

The end of the cold war and the resulting dismantlement of nuclear weapons has resulted in the need for the US to dispose of 50 to 100 metric tons of excess of plutonium in a safe and proliferation resistant manner. A number of studies, including the recently released National Academy of Sciences (NAS) study, have recommended conversion of plutonium into spent nuclear fuel with its high radiation barrier as the best means of providing permanent conversion and long-term diversion resistance to this material. The NAS study "Management and Disposition of Excess Weapons Plutonium identified Light Water Reactor spent fuel as the most readily achievable and proven form for the disposition of excess weapons plutonium. The study also stressed the need for a US disposition program which would enhance the prospects for a timely reciprocal program agreement with Russia. This summary provides the key findings of a GE study where plutonium is converted into Mixed Oxide (MOX) fuel and a typical 1155 MWe GE Boiling Water Reactor (BWR) is utilized to convert the plutonium to spent fuel. A companion study of the Advanced BWR has recently been submitted. The MOX core design work that was conducted for the ABWR enabled GE to apply comparable fuel design concepts and consequently achieve full MOX core loading which optimize plutonium throughput for existing BWRs.

293 (NEI-DK–1634, pp. 47) **The risk of nuclear weapons proliferation.** Oelgaard, P.L. (Technical University of Denmark (Denmark)). Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark). 1994. (CONF-9402114–: 2. Nordic safeguards seminar, Copenhagen (Denmark), 9-10 Feb 1994). In *2. Nordic safeguards seminar: Account.* [65p.] Source: Available on loan from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

Short communication. NUCLEAR WEAPONS/proliferation; PROLIFERATION; POLITICAL ASPECTS; RISK ASSESSMENT

294 (PB–94-179975/XAB) **Export controls and nonproliferation policy.** Office of Technology Assessment (U.S. Congress), Washington, DC (United States). May 1994. 94p. (OTA-ISS–596). Source: NTIS Prices: PC A05/MF A01.

Also available from Supt. of Docs.

The primary purpose of this report is to identify options for enhancing the effectiveness of export controls in slowing or preventing the spread of capabilities to develop and produce weapons of mass destruction. Nevertheless, reducing the burdens of export regulation on U.S. exporters has been a major focus of discussions about revising the Export Administration Act. Therefore, the report also examines policy options directed mainly toward the goal of reducing these burdens, but with special emphasis on their implications for nonproliferation policy.

295 (PB–94-209897/XAB) **Proliferation and the former Soviet Union.** Office of Technology Assessment (U.S. Congress), Washington, DC (United States). Sep 1994. 97p. (OTA-ISS–605). Source: NTIS Prices: PC A05/MF A02.

Also available from Supt. of Docs.

The report examines the whole range of consequences for proliferation of weapons of mass destruction of the Soviet Union's breakup and describes how U.S. assistance may reduce specific proliferation risks in the former Soviet Union.

296 (PB--94-868429/XAB) **Arms control. (Latest citations from the NTIS bibliographic database). Published Search.** NERAC, Inc., Tolland, CT (United States). Feb 1994. [10p.] Source: NTIS Prices: PC N01/MF N01.

Updated with each order. Supersedes PB--93-887891.

The bibliography contains citations concerning policies, global relations, and agreements pertaining to arms control. Strategic Arms Limitation Talks (SALT), security affairs, proliferation due to commercial uses of nuclear energy, and deterrence and disarmament are among the topics discussed. The military uses of space and the control and distribution of chemical warfare agents are also considered. (Contains a minimum of 239 citations and includes a subject term index and title list.)

297 (PB--94-887189/XAB) **Chemical and biological warfare: General studies. (Latest citations from the NTIS bibliographic database). Published Search.** NERAC, Inc., Tolland, CT (United States). Jul 1994. [10p.] Source: NTIS Prices: PC N01/MF N01.

Updated with each order. Supersedes PB--94-853231.

The bibliography contains citations concerning federally sponsored and conducted studies into chemical and biological warfare operations and planning. These studies cover areas not addressed in other parts of this series. The topics include production and storage of agents, delivery techniques, training, military and civil defense, general planning studies, psychological reactions to chemical warfare, evaluations of materials exposed to chemical agents, and studies on banning or limiting chemical warfare. Other published searches in this series on chemical warfare cover detection and warning, defoliants, protection, and biological studies, including chemistry and toxicology. (Contains 250 citations and includes a subject term index and title list.)

298 (PB--94-923501/XAB) **Dispatch Volume 5, Number 1, January 3, 1994.** Department of State, Washington, DC (United States). Bureau of Public Affairs. 3 Jan 1994. 16p. Source: NTIS Prices: PC A03/MF A01.

Contents: ambassador Strobe Talbott nominated as deputy secretary of state; Gore-Chernomyrdin commission; focus on Russia: highlights of successful US support for market reform; safe and secure dismantlement of nuclear weapons in the new independent states; the Visegrad group; Czech Republic; Hungary; Poland; and Slovakia.

299 (PB--94-923552/XAB) **Dispatch Volume 5, Number 52, December 26, 1994.** Department of State, Washington, DC (United States). Bureau of Public Affairs. 26 Dec 1994. 28p. Source: NTIS Prices: PC A03/MF A01.

;Contents: Advancing U.S.-Russian Cooperation; Country Profile: Russia; Fact Sheet: Gore-Chernomyrdin Commission; Fact Sheet: U.S.-Russian Economic Relations and Military Issues; Fact Sheet: Safe and Secure Dismantlement Of Nuclear Weapons in the New Independent States; Fact Sheet: U.S. Arctic Policy; Preventing the Proliferation of Dangerous Arms; Conference of Parties of the Convention On Biological Diversity; Fact Sheet: The International Coral Reef Initiative; U.S. Policy Review Toward Burma; Haitian Economic Assistance Program; and Fact Sheet: Department of State Foreign Affairs Network (DOSFAN).

300 (PB--94-928009/XAB) **US foreign policy and the CIA: A cold war retrospective.** Central Intelligence Agency, Washington, DC (United States). 1994. 1145p. Source: NTIS Prices: Standing Order.

The document consists of three previously announced reports: The CIA under Truman: CIA Cold War Records (PB94-928005); The Cuban Missile Crisis, 1962 (PB92-927906); and Selected Estimates on the Soviet Union (PB93-928112).

301 (PB--95-133815/XAB) **North Korean nuclear development program and Japan.** Cheng, D. Massachusetts Inst. of Tech., Cambridge, MA (United States). Center for International Studies. ©1994. 46p. (MITJP--92-08). Source: NTIS Prices: PC E04/MF E04.

See also AD-A282 674.

In the past year, the Northeast Asian security debate has been preoccupied with the status and potential implications of a North Korean nuclear program. Recently, one of the more common assertions has been that Japan may be on the verge of developing nuclear weapons in response to the North Korean nuclear program. Before such predictions are made, it is important to examine the extent of the North Korean nuclear program, and the likely ramifications of a North Korean nuclear capability. Only then is it possible to make any assessments of potential Japanese responses.

302 (PB--95-141941/XAB) **Research in the service of the Swedish National Defence. Publication list 1956-1994.** Orhaug, T.; Bjoerck, E.B. Foersvarets Forskningsanstalt, Linkoeping (Sweden). Huvudavdelning foer Informationsteknologi. Mar 1994. 34p. (FOA-C--30750-3.4). Source: NTIS Prices: PC A03/MF A01.

Text in Swedish; summary in English.

The document contains a list of documents and reports published 1956-1994 by Torleiv Orhaug, Director of Research at the National Defense Research Establishment in Sweden. Topics include: image processing, remote sensing, Open Skies, verification technology, and space technology.

303 (PB--95-206496/XAB) **Optimal distribution of IAEA inspection effort. Final research report.** Kilgour, D.M.; Avenhaus, R. Wilfrid Laurier Univ., Waterloo, ON (Canada). Laurier Centre for Military Strategic and Disarmament Studies. Oct 1994. 41p. Source: NTIS Prices: PC A03/MF A01.

Under the Treaty of the Non-Proliferation of Nuclear Weapons (NPT), the International Atomic Energy Agency (IAEA) has responsibility for implementing safeguards. Safeguards against undeclared nuclear weapons development programs need to be strengthened, yet at the same time concern has increased about the rising costs of safeguards programs. These fundamental problems are addressed in this report. Its objective is to present an assessment of current and potential levels of cost-effectiveness of inspections of nuclear materials and activities, and to suggest avenues for improvement. A specific framework demonstrating what determines required levels of inspection effectiveness is provided. With the help of the mathematical tools of Decision Theory and Game Theory, models are analyzed representing states' decisions to comply with or violate the NPT, and, if violation is chosen, where to violate. The models also

include the IAEA's decisions of where and how much to inspect.

304 (PB–95-854220/XAB) **Chemical and biological warfare: General studies. (Latest citations from the NTIS bibliographic database). NewSearch.** NERAC, Inc., Tolland, CT (United States). Oct 1994. [10p.] Source: NTIS Prices: PC N01/MF N01.

Updated with each order. Supersedes PB–94-887189.

The bibliography contains citations concerning federally sponsored and conducted studies into chemical and biological warfare operations and planning. These studies cover areas not addressed in other parts of this series. The topics include production and storage of agents, delivery techniques, training, military and civil defense, general planning studies, psychological reactions to chemical warfare, evaluations of materials exposed to chemical agents, and studies on banning or limiting chemical warfare. Other published searches in this series on chemical warfare cover detection and warning, defoliants, protection, and biological studies, including chemistry and toxicology. (Contains 250 citations and includes a subject term index and title list.)

305 (PB–95-858437/XAB) **Arms control. (Latest citations from the NTIS bibliographic database). Published Search.** NERAC, Inc., Tolland, CT (United States). Nov 1994. [10p.] Source: NTIS Prices: PC N01/MF N01.

Updated with each order. Supersedes PB–94-868429.

The bibliography contains citations concerning policies, global relations, and agreements pertaining to arms control. Strategic Arms Limitation Talks (SALT), security affairs, proliferation due to commercial uses of nuclear energy, and deterrence and disarmament are among the topics discussed. The military uses of space and the control and distribution of chemical warfare agents are also considered. (Contains 250 citations and includes a subject term index and title list.)

306 (PNL–9050) **A comparison of artificial neural networks and statistical analyses.** Blough, D.K.; Anderson, K.K. Pacific Northwest Lab., Richland, WA (United States). Jan 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010846. Source: OSTI; NTIS; GPO Dep.

Artificial neural networks have come to be used in a wide variety of data analytic applications, many of which were traditionally approached using statistical methods. It is the purpose of this paper to discuss the nature of the information obtained by each methodology, that of artificial neural networks and that of statistical analyses. Two aspects of the comparison will be considered: (1) what are the requirements needed for each approach in terms of model specification, data requirements, and computing power, and (2) what sort of information is contained in the results of each approach. Example analyses are presented characterizing the differences in the two approaches. A specific problem (hydrodynamic yield estimation) is presented with a corresponding data set. This data is then analyzed using statistical methods, and the results are compared with those obtained by using an artificial neural network. The requirements and results of the two approaches are then summarized as general guidelines an investigator can use in deciding which approach would be best for analyzing a given data set.

307 (PNL–9794) **The estimation of parameters in nonlinear, implicit measurement error models with experiment-wide measurements.** Anderson, K.K. Pacific Northwest Lab., Richland, WA (United States). May 1994. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012759. Source: OSTI; NTIS; GPO Dep.

Measurement error modeling is a statistical approach to the estimation of unknown model parameters which takes into account the measurement errors in all of the data. Approaches which ignore the measurement errors in so-called independent variables may yield inferior estimates of unknown model parameters. At the same time, experiment-wide variables (such as physical constants) are often treated as known without error, when in fact they were produced from prior experiments. Realistic assessments of the associated uncertainties in the experiment-wide variables can be utilized to improve the estimation of unknown model parameters. A maximum likelihood approach to incorporate measurements of experiment-wide variables and their associated uncertainties is presented here. An iterative algorithm is presented which yields estimates of unknown model parameters and their estimated covariance matrix. Further, the algorithm can be used to assess the sensitivity of the estimates and their estimated covariance matrix to the given experiment-wide variables and their associated uncertainties.

308 (PNL–9982) **Summary of near-term options for Russian plutonium production reactors.** Newman, D.F.; Gesh, C.J.; Love, E.F.; Harms, S.L. Pacific Northwest Lab., Richland, WA (United States). Jul 1994. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94016810. Source: OSTI; NTIS; INIS; GPO Dep.

The Russian Federation desires to phase out the production of weapons-grade plutonium. To this end, ten graphite-moderated, water-cooled reactors have been shut down during the last several years. However, complete cessation of plutonium production is impeded because the three operating Russian reactors supply district heat and electricity to the Tomsk and Krasnoyarsk regions in addition to producing weapon-grade plutonium. In August 1992 the Russian Federation Ministry of Atomic Energy (MINATOM) and the Russian Nuclear Regulatory Agency (GAN) requested U.S. assistance for achieving a cessation of weapons-grade plutonium production, placing the plutonium production reactors under safeguards, and conducting a program to evaluate and assist in the upgrade of plant safety. As a result of that and subsequent communications, Secretary O'Leary and Minister Mikhailov have signed a protocol that expressed their desire to shut down the three remaining plutonium production reactors as soon as possible by replacing them with alternate energy sources. In the meantime, both MINATOM and the Department of Energy (DOE) are concerned about the safety of the plants as well as the difficulty in ceasing the production of plutonium as long as the plants continue to operate. A military subsidy has been provided for operation of the production reactor complex. Revenues received for providing district heat and electricity are insufficient to cover costs for the current natural uranium metal fuel cycle. A more economical fuel cycle is needed for civilian operations.

309 (PNL–10054) **Statistical methods for enhancing change analysis in remote sensing.** Eggett, D.L.; Petrie, G.M. Pacific Northwest Lab., Richland, WA (United States). Aug 1994. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Source: OSTI.

REMOTE SENSING/statistical models; ARMS CONTROL/verification; IMAGE PROCESSING; COMPUTER CALCULATIONS; DATA PROCESSING; SATELLITES; MAPPING; VERIFICATION

310 (PNL–10102) **Airborne Multisensor Pod System (AMPS) data management overview.** Wiberg, J.D.; Blough, D.K.; Daugherty, W.R.; Hucks, J.A.; Gerhardstein, L.H.; Meitzler, W.D.; Melton, R.B.; Shoemaker, S.V. Pacific Northwest Lab., Richland, WA (United States). Sep 1994. 88p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE95000829. Source: OSTI; NTIS; GPO Dep.

An overview of the Data Management Plan for the Airborne Multisensor Pod System (AMPS) pro-grain is provided in this document. The Pacific Northwest Laboratory (PNL) has been assigned the responsibility of data management for the program, which includes defining procedures for data management and data quality assessment. Data management is defined as the process of planning, acquiring, organizing, qualifying and disseminating data. The AMPS program was established by the U.S. Department of Energy (DOE), Office of Arms Control and Non-Proliferation (DOE/AN) and is integrated into the overall DOE AN-10.1 technology development program. Sensors used for collecting the data were developed under the on-site inspection, effluence analysis, and standoff sensor program, the AMPS program interacts with other technology programs of DOE/NN-20. This research will be conducted by both government and private industry. AMPS is a research and development program, and it is not intended for operational deployment, although the sensors and techniques developed could be used in follow-on operational systems. For a complete description of the AMPS program, see "Airborne Multisensor Pod System (AMPS) Program Plan". The primary purpose of the AMPS is to collect high-quality multisensor data to be used in data fusion research to reduce interpretation problems associated with data overload and to derive better information than can be derived from any single sensor. To collect the data for the program, three wing-mounted pods containing instruments with sensors for collecting data will be flight certified on a U.S. Navy RP-3A aircraft. Secondary objectives of the AMPS program are sensor development and technology demonstration. Pod system integrators and instrument developers will be interested in the performance of their deployed sensors and their supporting data acquisition equipment.

311 (PNL–10186) **Recommended observational skills training for IAEA safeguards inspections: Final report: Recommended observational skills training for IAEA safeguards inspections.** Toquam, J.L.; Morris, F.A. Pacific Northwest Lab., Richland, WA (United States). Sep 1994. 118p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE95000977. Source: OSTI; NTIS; INIS; GPO Dep.

This is the second of two reports prepared to assist the International Atomic Energy Agency (IAEA or Agency) in enhancing the effectiveness of its international safeguards inspections through inspector training in "Observational Skills". The first (Phase 1) report was essentially exploratory. It defined Observational Skills broadly to include all appropriate cognitive, communications, and interpersonal techniques that have the potential to help IAEA safeguards inspectors function more effectively. It identified 10 specific Observational Skills components, analyzed their relevance to IAEA safeguards inspections, and reviewed a variety of inspection programs in the public and private sectors that provide training in one or more of these components. The report concluded that while it should be possible to draw upon these other programs in developing Observational Skills training for IAEA inspectors, the approaches utilized in these programs will likely require significant adaption to support the specific job requirements, policies, and practices that define the IAEA inspector's job. The overall objective of this second (Phase 2) report is to provide a basis for the actual design and delivery of Observational Skills training to IAEA inspectors. The more specific purposes of this report are to convey a fuller understanding of the potential application of Observational Skills to the inspector's job, describe inspector perspectives on the relevance and importance of particular Observational Skills, identify the specific Observational Skill components that are most important and relevant to enhancing safeguards inspections, and make recommendations as to Observational Skills training for the IAEA's consideration in further developing its Safeguards training program.

312 (PNL–10212) **A statistical review of Fast Filter.** Higbee, K.T. Pacific Northwest Lab., Richland, WA (United States). Dec 1994. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Source: OSTI.

This report is an evaluation of the satellite signature classification software called Fast Filter. Fast filter is used on both short and long profile events from satellite bhangmeters, and provides preliminary classification to reduce the number of events that require manual review and classification. The uninteresting natural events, such as lightning, should be screened out. Only those events identified as NUDETs (nuclear detonations) or those events whose classification is unclear should be passed on for human evaluation. It is imperative that all NUDETs be classified as NUDETs or be sent on for human evaluation. Additionally, with the large number of events that occur daily, it is important to reduce the number of identified events requiring manual inspection. The Fast Filter algorithm must be defensible in terms of: The physical principles upon which it is based; the statistical procedures upon which it relies; and the computer programming that implements it. The emphasis in this report is on evaluating the statistical algorithms used in Fast Filter. Some issues relating to the physics and programming of the algorithm are also presented. This report: Outlines the problems found in Fast Filter; discusses solutions to these problems; provides recommendations for improving Fast Filter; and shows graphical examples illustrating the concepts presented.

313 (PNL-SA–22129) **Environmental sampling and analysis as a safeguards tool.** Perkins, R.W.; Wogman,

N.A.; Holdren, G.R. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9303158–2: International Atomic Energy Agency (IAEA) consultant's meeting; International symposium on nuclear material safeguards, Vienna (Austria); Vienna (Austria), 30 Mar - 2 apr 1993; 14-18 mar 1994; CONF-940307–30). Order Number DE93018873. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental sampling and radionuclide analysis of the resulting material can be utilized as a supplemental approach in safeguarding practices and particularly for detection of undeclared nuclear activities. The production of nuclear weapons could be pursued by uranium enrichment processes to produce highly enriched U-235 or by nuclear reactor operations followed by chemical separations to produce Pu-239. The application of either of these processes results in the production of signature materials, some of which will be released to the environs. Results from the operations of the Hanford production facilities are discussed and indicate the type of signatures that may be expected from plutonium production facilities. These include noble gas emissions from the reactors and chemical separations processes, the production of radionuclides in reactor cooling water followed by their subsequent release to the Columbia River, and the release of mildly contaminated process water from the chemical processing facilities. These signature materials are carried by both gaseous and liqid effluents and enter various compartments of the environment. The types of signature materials which are most likely to be accumulated are discussed, together with examples of the quantities which have been released during past separations. There are numerous processes by which natural uranium may be enriched to produce highly enriched U-235. The most definitive signature of such processes is always a modification in uranium isotope ratios, and materials showing either enriched or depleted uranium in gaseous and liquid effluents provide the best indication that uramium enrichment processes are taking place. Therefore, techniques for sampling and analysis of airborne, waterborne, or deposited uranium in environmental matrices provide a means of detecting uranium enrichment which may lead to proliferation products.

314 (PNL-SA–23640) **International Nuclear Safeguards Inspection Support Tool.** Steinmaus, K.L.; Wukelic, G.E.; Beal, O.M. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940307–27: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994). Order Number DE94011675. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) is committed to developing technologies to meet escalating requirements for the International Atomic Energy Agency (IAEA) Non-Proliferation Treaty (NPT) monitoring and associated inspections. This commitment involves the customization and transfer of existing remote monitoring/information management technologies for use by the IAEA. This paper describes an information management system called INSIST International Nuclear Safeguards Inspection Support Tool, which was developed by the Pacific Northwest Laboratory (PNL) to support the IAEA Action Team in its role of monitoring and verifying compliance under United Nations Special Commission (UNSC) Resolutions 687, 707, and 715. Initial emphasis was placed on developing and deploying functionality and databases customized to support the Action Team. Throughout the design and customization of INSIST, emphasis was placed on information storage and retrieval capabilities for data gathered by the Action Team. In addition, PNL provided the Action Team with maps and satellite images and other relevant Iraqi databases to further facilitate the following activities: monitoring nuclear activities, facility operations, and nuclear material inventories assisting in inspection planning and training providing post inspection analysis providing on-site inspection support reporting on inspection findings.

315 (PNL-SA–23966) **Dynamic Bayesian filtering for real-time seismic analyses.** Blough, D.K.; Rohay, A.C.; Anderson, K.K.; Nicholson, W.L. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9404100–10: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94015206. Source: OSTI; NTIS; GPO Dep.

State space modeling, which includes techniques such as the Kalman filter, has been used to analyze many non-stationary time series. The ability of these dynamic models to adapt and track changes in the underlying process makes them attractive for application to the real-time analysis of three-component seismic waveforms. The authors are investigating the application of state space models formulated as Bayesian time series models to phase detection, polarization, and spectrogram estimation of seismograms. This approach removes the need to specify data windows in the time series for time averaging estimation (e.g., spectrum estimation). They are using this model to isolate particular seismic phases based on polarization parameters that are determined at a spectrum of frequencies. They plan to use polarization parameters, frequency spectra, and magnitudes to discriminate between different types of seismic sources. They present the application of this technique to artificial time series and to several real seismic events including the Non-Proliferation Experiment (NPE) two nuclear tests and three earthquakes from the Nevada Test site, as recorded on several regional broadband seismic stations. A preliminary result of this analysis indicates that earthquakes and explosions can potentially be discriminated on the bass of the polarization characteristics of scattered seismic phases. However, the chemical (NPE) and nuclear explosions appear to have very similar polarization characteristics.

316 (PNL-SA–24301) **Ultra wide band millimeter wave holographic "3-D" imaging of concealed targets on mannequins.** Collins, H.D. (Pacific Northwest Lab., Richland, WA (United States). Acoustics & Electromagnetic Imaging Group); Hall, T.E.; Gribble, R.P. Pacific Northwest Lab., Richland, WA (United States). Aug 1994. 7p. Sponsored by Federal Aviation Administration, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9407123–1: 1994 review of progress in quantitative nondestructive evaluation conference, Snowmass, CO (United States), 31 Jul - 5 aug 1994). Order Number DE94017482. Source: OSTI; NTIS; GPO Dep.

Ultra wide band (chirp frequency) millimeter wave "3-D" holography is a unique technique for imaging concealed targets on human subjects with extremely high lateral and depth resolution. Recent "3-D" holographic images of full size mannequins with concealed weapons illustrate the efficacy of this technique for airport security. A chirp frequency (24 GHz to 40 GHz) holographic system was used to construct extremely high resolution images (optical quality) using polyrod antenna in a bi-static configuration using an x-y scanner. Millimeter wave chirp frequency holography can be simply described as a multi-frequency detection and imaging technique where the target's reflected signals are decomposed into discrete frequency holograms and reconstructed into a single composite "3-D" image. The implementation of this technology for security at airports, government installations, etc., will require real-time (video rate) data acquisition and computer image reconstruction of large volumetric data sets. This implies rapid scanning techniques or large, complex "2-D" arrays and high speed computing for successful commercialization of this technology.

317 (PNL-SA–24712) **Initiatives in the US nuclear material tracking system.** Smith, M.R. (Department of Energy, Washington, DC (United States)); Kuzmycz, G.; Heaton, E.R. Pacific Northwest Lab., Richland, WA (United States). Jul 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940748–94: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94018929. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy (DOE) Office of Nonproliferation and National Security is in the process of developing a new worldwide nuclear materials tracking system. Its purpose is for DOE to better fulfill its international and domestic nuclear material tracking obligations and needs. The Lawrence Livermore National Laboratory (LLNL), is developing the International Nuclear Analysis (INA) Program to meet this goal. LLNL will assume the function and duties of the current Nuclear Materials management and Safeguards System (NMMSS) operated by Martin Marietta Energy Systems. The program is jointly funded by the DOE, the Nuclear Regulatory Commission and the US Enrichment Corporation.

318 (PNL-SA–24889) **Wide-area monitoring to detect undeclared nuclear facilities.** Wogman, N. Pacific Northwest Lab., Richland, WA (United States). Sep 1994. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9409247–1: International Atomic Energy Agency conference, Vienna (Austria), 19-21 Sep 1994). Order Number DE95003131. Source: OSTI; NTIS; INIS; GPO Dep.

The International Atomic Energy Agency (IAEA) is committed to strengthening and streamlining the overall effectiveness of the IAEA safeguards system. The IAEA is investigating the use of environmental monitoring techniques to strengthen its capability to detect undeclared nuclear activities. The IAEA's Program 93+2 Initiative has been established to develop, test, and assess strengthening techniques and measures. Some of the techniques have been validated and are being implemented during routine safeguards inspections. The effectiveness of other techniques is being studied as a part of extensive field trials conducted at nuclear facilities of various Member States during 1993 and 1994. Proposals based on the results of these investigations and recommendations for new safeguards activities are expected to be presented to the March 1995 Board of Governors Meeting. The techniques in use or under study during IAEA field trials address various types of environmental monitoring applications as outlined under Program 93+2's Task 3, Environmental Monitoring Techniques for Safeguards Applications, namely, the use of short-range monitoring during inspections and visits to investigate sites of possible undeclared activities. With the exception of wide-area water sampling in Iraq, the use of long-range monitoring, in the absence of any indication of undeclared nuclear activities, remains largely unexamined by the IAEA. The efficacy of long-range monitoring depends on the availability of mobile signature isotopes or compounds and on the ability to distinguish the nuclear signatures from background signals and attributing them to a source. The scope of this paper is to provide technical information to the International Atomic Energy Agency (IAEA) on possible wide-area survey techniques for the detection of undeclared nuclear activities. The primary focus is the detection of effluents from reprocessing activities.

319 (PNL-SA–25439) **Hanford/Tomsk reciprocal site visit: Plutonium agreement compliance talks.** Libby, R.A.; Sorenson, R.; Six, D.; Schiegel, S.C. Pacific Northwest Lab., Richland, WA (United States). Nov 1994. 201p. (In English, Russian). Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9411211–: Hanford/Tonsk reciprocal site visit: plutonium agreement compliance talks, Richland, WA (United States), 14-17 Nov 1994). Order Number DE95008941. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of the visit to Hanford Site was to: demonstrate equipment, technology, and methods for calculating Pu production, measuring integrated reactor power, and storing and safeguarding PuO_2; demonstrate the shutdown of Hanford production reactors; and foster openness and transparency of Hanford operations. The first day's visit was an introduction to Hanford and a review of the history of the reactors. The second day consisted of discussions on the production reactors, reprocessing operations, and PuO_2 storage. The group divided on the third day to tour facilities. Group A toured the N reactor, K-West reactor, K-West Basins, B reactor, and participated in a demonstration and discussion of reactor modeling computer codes. Group B toured the Hanford Pu Storage Facility, 200-East Area, N-cell (oxide loadout station), the Automated Storage Facility, and the Nondestructive Assay Measurement System. Group discussions were held during the last day of the visit, which included scheduling of a US visit to Russia.

320 (SAND–91-8010/1) **The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings: Volume 1, Introduction and summary.** Rinne, R.L. (ed.). Sandia National Labs., Livermore, CA (United States). Feb 1994. 70p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-9009546–Vol.1: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). Order Number DE94008232. Source: OSTI; NTIS; GPO Dep.

This conference was organized to study and analyze the role of simulation, analysis, modeling, and exercises in the history of NATO policy. The premise was not that the results of past studies will apply to future policy, but rather that understanding what influenced the decision process – and how – would be of value. The structure of the conference was built around discussion panels. The panels were augmented by a series of papers and presentations focusing on particular TNF events, issues, studies or exercise. The conference proceedings consist of three volumes. This volume, Volume 1, contains the conference introduction, agenda, biographical sketches of principal participants, and analytical summary of the presentations and discussion panels. Volume 2 contains a short introduction and the papers and presentations from the conference. Volume 3 contains selected papers by Brig. Gen. Robert C. Richardson III (Ret.).

321 (SAND–91-8010/2) **The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings: Volume 2: Papers and presentations.** Rinne, R.L. Sandia National Labs., Livermore, CA (United States). Feb 1994. 336p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). Order Number DE94009227. Source: OSTI; NTIS; INIS; GPO Dep.

This conference was organized to study and analyze the role of simulation, analysis, modeling, and exercises in the history of NATO policy. The premise was not that the results of past studies will apply to future policy, but rather that understanding what influenced the decision process – and how – would be of value. The structure of the conference was built around discussion panels. The panels were augmented by a series of papers and presentations focusing on particular TNF events, issues, studies, or exercises. The conference proceedings consist of three volumes. Volume 1 contains the conference introduction, agenda, biographical sketches of principal participants, and analytical summary of the presentations and panels. This volume contains a short introduction and the papers and presentations from the conference. Volume 3 contains selected papers by Brig. Gen. Robert C. Richardson III (Ret.). Individual papers in this volume were abstracted and indexed for the database.

322 (SAND–91-8010/2, pp. 9-36) **The pentomic experience.** Gold, T. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The Pentomic experience is presented in outline form. The subject is discussed under the following topics: context, objectives, description, assessment, and lessons. The context included President Eisenhower's "new look" strategy and service rivalry for nuclear share. The objectives for the Pentomic Division included dual capability with nuclear emphasis, strategic mobility, smaller, and major organizational changes. The Pentomic Division is described as a separate division in which the infantry battle group is a basic building block. The Pentomic Division was designed to be dual-capable in both conventional and nuclear warfare and was assessed or perceived to be neither. The possible reasons for the failure of the concept were: problem too hard, wrong solution, premature solution, weak implementation, and overambitious goals.

323 (SAND–91-8010/2, pp. 37-48) **Project ATTACK and Project VISTA: Benchmark studies on the road to NATO's early TNF policy.** Garrity, P.J. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

This paper is concerned with those studies and analyses that affected early NATO nuclear policy and force structure. The discussion focuses specifically on two "benchmark" activities. Project VISTA and Project ATTACK. These two studies were chosen less because one can document their direct impact on NATO nuclear policy and more because they capture the state of thinking about tactical nuclear weapons at a particular point of time. Project VISTA offers an especially important benchmark in this respect. Project ATTACK is a rather different kind of benchmark. It is not a pathbreaking study. It is much narrower and more technical than VISTA. It appears to have received no public attention. Project ATTACK is interesting because it seems to capture a "nuts-and-bolts" feel for how U.S. (and thereby NATO) theater nuclear policy was evolving prior to MC 48. The background and context for Project VISTA and Project ATTACK are presented and discussed.

324 (SAND–91-8010/2, pp. 49-66) **Summary of remarks by R.C. Richardson: NATO's basic TNF problem and principal posture findings.** Richardson, R.C. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The use of atomic weapons in NATO defense planning seems to be an issue of special interest to writers and historians. It is also an issue fraught with confusion for the official record of actions taken does not tell the whole story. Both writers and historians seem to be having a hard time getting a clear and agreed position on this subject and for good reasons. Reasons which are not generally understood although important not only to history but also to future U.S. security planning. The confusion over tactical nuclear planning in NATO can be traced to the early 1950s when the Alliance was faced with the need to develop and present a credible defense posture for its European members while being unable to field classic force levels anywhere near comparable to those of the Warsaw Pact nations that threatened them. A summary paper is presented in two parts. Part I explains what the Basic TNF Problem appears to be and how it came about and Part II discusses examples of the type of corrective measures that should have been - and still should be - taken.

325 (SAND–91-8010/2, pp. 67-114) **Nuclear weapons and NATO operations: Doctrine, studies, and exercises.** Karber, P.A. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

A listing of papers is presented on the doctrine, studies, and exercises dealing with nuclear weapons and NATO operations for the period 1950-1983. The papers deal with studies on massive retaliation, sword and shield, and flexible response. Some of the enduring issues of nuclear weapons in NATO are listed.

326 (SAND–91-8010/2, pp. 115-136) **The role of studies and analysis in the Berlin crisis.** Schake, K. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The question posed for this conference was whether military exercises, studies and analysis have made an appreciable difference in the policies associated with tactical nuclear forces (TNF) in the North Atlantic Treaty Organization (NATO). Some of the papers leave the impression that studies, analysis and military exercises have very little impact on the strategy, policy decisions and force posture of NATO tactical nuclear forces. The studies and analyses undertaken during the 1961 Berlin crisis suggest a very different conclusion: that studies and analyses, when specific in scope and carrying some sense of immediacy, can be enormously influential. Whether one considers the changes to be positive or negative, the experience of the 1961 Berlin crisis suggests that studies and analyses had a tangible and direct impact both on contingency planning for the Berlin crisis specifically and on discussions of the role of tactical nuclear forces more broadly. The results of these studies and analyses are discussed.

327 (SAND–91-8010/2, pp. 137-152) **The sword-shield strategy of the early 1960s.** Steinhoff, J. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The sword and shield strategy of the post WWII German Federal Republic is discussed. The effort to rebuild the German air force following WWII is outlined. This effort was initiated in 1956 with material furnished by the US through the Nash Plan. The debate surrounding the validity of the sword-shield concept is described.

328 (SAND–91-8010/2, pp. 153-168) **The follow-on use studies.** Brown, G. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

NATO's follow-on use studies for the period 1969-1973 are outlined under the following topics: background, follow-on use study program (phases), transition to nuclear warfare, primary policy documents (phase III), additional sources (phase III), nuclear policy evolution - the decade of the 70's, and NATO TNF Policy - summary questions.

329 (SAND–91-8010/2, pp. 169-194) **NATO's requirements and policy for LRTNF.** Davis, L.E. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

In a special meeting of Foreign and Defense Ministers, the NATO alliance on 12 December 1979 decided to modernize its long range theater nuclear forces (LRTNF) through the deployment in Europe of 572 Pershing II and ground launched cruise missiles (GLCM). This decision was accompanied by an offer from the US to the U.S.S.R. to negotiate limitations on these LRTNF which would be global, equal, and verifiable. The story of NATO's dual-track decision as well as the INF Treaty is well chronicled. What is missing is a detailed study of the processes within the US government and the NATO alliance by which the LRTNF decisions were made. The role that analysis played, and the lessons that can be drawn for future policies on NATO's theater nuclear forces are discussed.

330 (SAND–91-8010/2, pp. 195-212) **Development of the follow-on force attack strategy.** Braddock, J.; Starry, D. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The development of the follow-on force attack strategy is outlined. The strategy is discussed under the following topics: relative locations, commitment of second echelon, type front deployment for offensive operation, unique assessment, activities, area for representative front, army, division, resulting improvements, background, essential elements of analysis, developing target processes, relative locations of possible assembly areas analyzed, second echelon queques, and illustration of Soviet concept of operations.

331 (SAND–91-8010/2, pp. 213-288) **U.S. Theater Nuclear Policy.** Thompson, J.A. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

In the brief period between May 1978 and December 12, 1979, U.S. policy, and the policy of the NATO Alliance, toward theater nuclear forces (TNF) changed dramatically. The consequences of this change now dominate the political agenda in East-West (and West-West) relations. The ultimate outcome of the now renamed intermediate-range nuclear force (INF) debate will have far-reaching consequences for the future of the Atlantic Alliance. How did this issue emerge? Why did the US change its policy? How did it work with its Alliance to change NATO policy? These questions, among others, are now figuring in the debate. The answers to these questions are discussed in detail.

332 (SAND–91-8010/2, pp. 289-308) **Evolution of Soviet Theater Nuclear Forces.** Atkeson, E.B. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

Soviet theater nuclear forces were a major pillar of Soviet superpower strength, rising sharply under Krushchev in the latter 1950s to their zenith under Brezhnev twenty years later. Most recently they have begun their decline under Gorbachev, and while not yet facing extinction, may be headed for a much reduced role under the new thinking in the USSR. This paper deals with the Soviet TNF in six periods of their life: The Post-war Stalin Period (1945-1953), the Post-Stalin Period (1953-1955), The Transition Period (1955-1959), The Period of Nuclear Revolution (1960-1964), The Period of Modern TNF Planning (1965-1980), and The Period of Non-nuclear Planning (1980-1987).

333 (SAND–91-8010/2, pp. 309-333) **Concluding remarks: Reflections on the forty year's history of TNF.** Martin, L.W. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The History of NATO's TNF policy is much wider than it may first appear, for NATO TNF policy has been the heart of the whole nuclear question since shortly after it was first so dramatically posed in 1945. Admittedly the ultimate foundation of deterrence has been the overarching balance of strategic nuclear weapons between the two Superpowers. These have provided the strategic "monitor" of ultimately unacceptable damage that inspires cautious behavior at lower levels of conflict. But if the strategic weapons inculcate the caution, it has been with TNF that the opposing blocs have chiefly tried to harness nuclear weapons to particular situations and manipulate them to their advantage. The key characteristic of nuclear weapons that distinguishes them from all others is their virtually unlimited destructive potential. Powers disposing of large strategic nuclear forces cannot readily, perhaps ever, be deprived of an ultimate capacity to do outrageous harm. If they are to be defeated, it must therefore be by outmaneuvering them so that they yield the essential prizes without recourse to their worst possibilities. If nuclear weapons are to be used in this process, whether actually or by latent influence on particular issues, it must be in some limited form. NATO's TNF policy constitutes the best example of this so far in nuclear history.

334 (SAND–91-8010/3) **The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings: Volume 3: Papers by Gen. Robert C. Richardson III (Ret.).** Rinne, R.L. (ed.). Sandia National Labs., Livermore, CA (United States). Feb 1994. 220p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE94007465. Source: OSTI; NTIS; GPO Dep.

This conference was organized to study and analyze the role of simulation, analysis, modeling, and exercises in the history of NATO policy. The premise was not that the results of past studies will apply to future policy, but rather that understanding what influenced the decision process-and how-would be of value. The structure of the conference was built around discussion panels. The panels were augmented by a series of papers and presentations focusing on particular TNF events, issues, studies, or exercises. The conference proceedings consist of three volumes. Volume 1 contains the conference introduction, agenda, biographical sketches of principal participants, and analytical summary of the presentations and discussion panels. Volume 2 contains a short introduction and the papers and presentations from the conference. This volume contains selected papers by Brig. Gen. Robert C. Richardson III (Ret.).

335 (SAND–93-2687) **Sandia Technology engineering and science accomplishments.** Sandia National Labs., Albuquerque, NM (United States). Feb 1994. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94008312. Source: OSTI; NTIS; GPO Dep.

This report briefly discusses the following research being conducted at Sandia Laboratories: Advanced Manufacturing – Sandia technology helps keep US industry in the lead; Microelectronics-Sandia's unique facilities transform research advances into manufacturable products; Energy – Sandia's energy programs focus on strengthening industrial growth and political decisionmaking; Environment – Sandia is a leader in environmentally conscious manufacturing and hazardous waste reduction; Health Care – New biomedical technologies help reduce cost and improve quality of health care; Information & Computation – Sandia aims to help make the information age a reality; Transportation – This new initiative at the Labs will help improve transportation, safety,l efficiency, and economy; Nonproliferation – Dismantlement and arms control are major areas of emphasis at Sandia; and Awards and Patents – Talented, dedicated employees are the backbone of Sandia's success.

336 (SAND–93-2750) **Optoelectronic inventory system for special nuclear material.** Sieradzki, F.H. Sandia National Labs., Albuquerque, NM (United States). Jan 1994. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94006258. Source: OSTI; NTIS; INIS; GPO Dep.

In support of the Department of Energy's Dismantlement Program, the Optoelectronics Characterization and Sensor Development Department 2231 at Sandia National Laboratories/New Mexico has developed an in situ nonintrusive Optoelectronic Inventory System (OIS) that has the potential

for application wherever periodic inventory of selected material is desired. Using a network of fiber-optic links, the OIS retrieves and stores inventory signatures from data storage devices (which are permanently attached to material storage containers) while inherently providing electromagnetic pulse immunity and electrical noise isolation. Photovoltaic cells (located within the storage facility) convert laser diode optic power from a laser driver to electrical energy. When powered and triggered, the data storage devices sequentially output their digital inventory signatures through light-emitting diode/photo diode data links for retrieval and storage in a mobile data acquisition system. An item's exact location is determined through fiber-optic network and software design. The OIS provides an on-demand method for obtaining acceptable inventory reports while eliminating the need for human presence inside the material storage facility. By using modularization and prefabricated construction with mature technologies and components, an OIS installation with virtually unlimited capacity can be tailored to the customer's requirements.

337 (SAND–94-0024) **Lidar technologies for airborne and space-based applications.** Henson, T.D. (Sandia National Labs., Albuquerque, NM (United States)); Schmitt, R.L.; Sobering, T.J.; Raymond, T.D.; Stephenson, D.A. Sandia National Labs., Albuquerque, NM (United States). Oct 1994. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE95002954. Source: OSTI; NTIS; INIS; GPO Dep.

This study identifies technologies required to extend the capabilities of airborne light detection and ranging (lidar) systems and establish the feasibility of autonomous space-based lidars. Work focused on technologies that enable the development of a lightweight, low power, rugged and autonomous Differential Absorption Lidar (DIAL) instruments. Applications for airborne or space-based DIAL include the measurement of water vapor profiles in support of climate research and processing-plant emissions signatures for environmental and nonproliferation monitoring. A computer-based lidar performance model was developed to allow trade studies to be performed on various technologies and system configurations. It combines input from the physics (absorption line strengths and locations) of the problem, the system requirements (weight, power, volume, accuracy), and the critical technologies available (detectors, lasers, filters) to produce the best conceptual design. Conceptual designs for an airborne and space-based water vapor DIAL, and a detailed design of a ground-based water vapor DIAL demonstration system were completed. Future work planned includes the final testing, integration, and operation of the demonstration system to prove the capability of the critical enabling technologies identified.

338 (SAND–94-0086) **Discrimination between NTS explosions, earthquakes and the non-proliferation experiment at the Pinedale Seismic Research Facility.** Carr, D. Sandia National Labs., Albuquerque, NM (United States). Sep 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE95001414. Source: OSTI; NTIS; INIS; GPO Dep.

As the United States moves into an atmosphere of concern about the spread of nuclear weapons to non-nuclear countries, the focus on monitoring nuclear explosions is changing from looking at specific test sites and yields to looking for tests of large and small yields from anywhere in the world. Discrimination of small events then becomes important and regional seismic monitoring the best method to detect and identify suspicious events. At the Pinedale Seismic Research Facility (PSRF) in Wyoming we have the opportunity to try different regional discriminants with nuclear tests from NTS, western US (W-US) earthquakes and the Non-Proliferation Experiment (NPE). Four discriminants that gave the best results in a study by Taylor et al. were tried: m_b:M_s, M_b:M_s^h, $\log(L_g/P_g)$ and spectral ratios. The different discriminants were applied to the data (14 NTS explosions, the NPE, one Department of Defense (DOB) explosion and 34 NWS earthquakes) regardless of signal-to-noise. When the NTS explosions and NPE were only compared to four earthquakes located on or near the Test Site, all the discriminants except $\log(L_g/P_g)$ worked fairly well at PSRF. When the other WUS earthquakes and DOD explosion are included, only m_b:M_s shows any promise. Because of frequent physical variations in the earth's crust, regional signals are complex and easily influenced by site and path characteristics. Looking at events from one specific area reduces the effects of the path, which is why three discriminants work well when the data set is restricted to events on or near NTS. The only discriminant not adversely affected from variations in path is m_b:M_s. This is probably because it is believed that source dimension, source time function and/or source mechanism is the cause for the differences between earthquakes and explosions with this discriminant, rather than any path effects.

339 (SAND–94-0154C) **NPE: Close-in stress and motion measurements.** Smith, C.W. Sandia National Labs., Albuquerque, NM (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000 ; AC04-76DP00789. (CONF-9404110–2: 3. FedUNIX annual conference on system administration, networking, and security, Washington, DC (United States), 4-9 Apr 1994). Order Number DE94010385. Source: OSTI; NTIS; GPO Dep.

On the Non-Proliferation Experiment, we measured stresses and accelerations in the nonlinear regime. Measurements were made in the host rock and in the grout stemming of the access drift. The thrust of the measurements was to provide data for a comparison with waveforms from nuclear events and with calculations of the process. Measured stress waveforms show greater amplitudes than yield-scaled waveforms from nearby nuclear events. Specifically, the five stress peaks suggest an equivalent nuclear yield of more than two kilotons. Material velocity data from NPE also show amplitudes greater than nuclear data. The risetimes of the NPE data are slower than risetimes of scaled nuclear data. The ratio of risetimes is about two; this difference may prove useful in discriminating between nuclear and chemical explosions. Non-radial accelerations show some departure from symmetric wave propagation. Tuff strengths – inferred from differences between radial and hoop stresses – show values that are about twice laboratory determined values.

340 (SAND–94-0229C) **DSMC simulation of low density nozzle expansion flow fields.** Bartel, T.J.; Sterk, T.M.; Preppernau, B.; Payne, J. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940625–2: 6. AIAA/ASME thermophysics and heat transfer conference, Colorado Springs, CO (United States), 20-23 Jun 1994). Order Number DE94007867. Source: OSTI; NTIS; GPO Dep.

Detection of trace chemical species is a difficult and time consuming process. A new area of interest for acquiring this capability is in environmental monitoring and nuclear treaty verification. An effective alternative to current techniques may be expanding a gas mixture through a nozzle and employing beam diagnostic techniques to monitor signal time of arrival. The differences in the inertia of the species alters the arrival time and the signal strength in the rapidly expanding flow field. In this investigation, the DSMC technique of Bird has been used to evaluate nozzle designs for this technique and predict specie mass and concentration ratios. Experimental measurements using beam fluorescence will be compared with the numerical simulations. The flow field of interest varies from approximately atmospheric at the nozzle throat to 10^{-6} torr in the chamber. Techniques to allow the DSMC technique to be applied in the high density region will be presented and compared with continuum simulations.

341 (SAND–94-0293C) **The Non-Proliferation Experiment recorded at the Pinedale: Seismic research facility.** Carr, D.B. Sandia National Labs., Albuquerque, NM (United States). [1994]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405158–1: Department of Energy symposium on the non-proliferation experiment results and implications for test ban treaties, Washington, DC (United States), 19-21 May 1994). Order Number DE94012917. Source: OSTI; NTIS; INIS; GPO Dep.

The Non-Proliferation Experiment was recorded by five different seismic stations operated by Sandia National Laboratories at the Pinedale Seismic Research Facility, approximately 7.60 from the Nevada Test Site. Two stations are different versions of the Deployable Seismic Verification System developed by the Department of Energy to provide seismic data to verify compliance with a Comprehensive Test Ban Treaty. Vault and borehole versions of the Designated Seismic Stations also recorded the event. The final station is test instrumentation located at depths of 10, 40 and 1200 feet. Although the event is seen clearly at all the stations, there are variations in the raw data due to the different bandwidths and depths of deployment. One Deployable Seismic Verification System has been operating at Pinedale for over three years and in that time recorded 14 nuclear explosions and 4 earthquakes from the Nevada Test Site, along with numerous other western U.S. earthquakes. Several discriminants based on the work by Taylor et al. (1989) have been applied to this data. First the discriminants were tested by comparing the explosions only to the 4 earthquakes located on the Test Site. Only one discriminant, $\log(L_g/P_g)$, did not show clear separation between the earthquakes and nuclear explosions. When other western U.S. events are included, only the m_b vs. M_s discriminant separated the events. In all cases where discrimination was possible, the Non-Proliferation Experiment was indistinguishable from a nuclear explosion.

342 (SAND–94-0441C) **Portable, solid state, fiber optic coupled Doppler interferometer system for detonation and shock diagnostics.** Fleming, K.J.; Crump, O.B. Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940245–5: 1994 National Aeronautics and Space Administration pyrotechnic systems workshop, Albuquerque, NM (United States), 8-9 Feb 1994). Order Number DE94007375. Source: OSTI; NTIS; GPO Dep.

VISAR (Velocity Interferometer System for Any Reflector) is a specialized Doppler interferometer system that is gaining world-wide acceptance as the standard for shock phenomena analysis. The VISAR's large power and cooling requirements, and the sensitive and complex nature of the interferometer cavity have restricted the traditional system to the laboratory. This paper describes the new portable VISAR, its peripheral sensors, and the role it played in optically measuring ground shock of an underground nuclear detonation. The solid State VISAR uses a prototype diode pumped ND:YAG laser and solid state detectors that provide a suitcase-size system with low power requirements. A special window and sensors were developed for fiber optic coupling (1 kilometer long) to the VISAR. The system has proven itself as a reliable, easy to use instrument that is capable of field test use and rapid data reduction using only a notebook personal computer (PC).

343 (SAND–94-0783C) **Input shaping for three-dimensional slew maneuvers of a precision pointing flexible spacecraft.** Dohrmann, C.R.; Robinett, R.D. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9406133–1: 1994 American control conference, Baltimore, MD (United States), 29 Jun - 1 jul 1994). Order Number DE94008937. Source: OSTI; NTIS; GPO Dep.

A method is presented for input torque shaping for three-dimensional slew maneuvers of a precision pointing flexible spacecraft. The method determines the torque profiles for fixed-time, rest-to-rest maneuvers which minimizes a specified performance index. Spacecraft dynamics are formulated in such a manner that the rigid body and flexible motions are decoupled. Furthermore, assembly by making use of finite element analysis results. Input torque profiles are determined by solving an associated optimization problem using dynamic programming. Three example problems are provided to demonstrate the application of the method.

344 (SAND–94-1265) **Public perspectives of nuclear weapons in the post-cold war environment.** Jenkins-Smith, H.C. (Univ. of New Mexico, Albuquerque, NM (United States). Institute for Public Policy); Herron, K.G.; Barke, R.P. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 140p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94015167. Source: OSTI; NTIS; GPO Dep.

This report summarizes the findings of a nationwide survey of public perceptions of nuclear weapons in the post-cold war environment. Participants included 1,301 members of the general public, 1,155 randomly selected members of the Union of Concerned Scientists, and 1,226 employees randomly selected from the technical staffs of four DOE national laboratories. A majority of respondents from all three samples perceived the post-cold war security environment

to pose increased likelihood of nuclear war, nuclear proliferation, and nuclear terrorism. Public perceptions of nuclear weapons threats, risks, utilities, and benefits were found to systematically affect nuclear weapons policy preferences in predictable ways. Highly significant relationships were also found between public trust and nuclear weapons policy preferences. As public trust and official government information about nuclear weapons increased, perceptions of nuclear weapons management risks decreased and perceptions of nuclear weapons utilities and benefits increased. A majority of respondents favored decreasing funding for: (1) developing and testing new nuclear weapons; (2) maintaining existing nuclear weapons, and (3) maintaining the ability to develop and improve nuclear weapons. Substantial support was found among all three groups for increasing funding for: (1) enhancing nuclear weapons safety; (2) training nuclear weapons personnel; (3) preventing nuclear proliferation; and (4) preventing nuclear terrorism. Most respondents considered nuclear weapons to be a persistent feature of the post-cold war security environment.

345 (SAND–94-1527C) **Crisis Prevention Centers as confidence building measures: Suggestions for Northeast Asia.** Pregenzer, A.L. Sandia National Labs., Albuquerque, NM (United States). [1994]. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405171–1: Northeast Asia cooperation dialog, Tokyo (Japan), 15-17 May 1994). Order Number DE94013768. Source: OSTI; NTIS; GPO Dep.

Relationships between countries normally war and peace. Crisis prevention activities will be particularly important in this area, and should have two goals: (1) stabilizing tense situations that could push countries toward war and (2) supporting or reenforcing efforts to move countries toward a state of peace. A Crisis Prevention Center (CPC) will facilitate efforts to achieve these goals and its functions can be grouped into three broad, inter-related categories: (1) establishing and facilitating communication among participating countries, (2) supporting negotiations and consensus-building on regional security issues, and (3) supporting implementation of agreed confidence and security building measures. Appropriate activities in each of these categories will depend on the relations among participating countries. Technology will play a critical role in a establishing communication systems to ensure the timely flow of information between countries and to provide the means for organizing and analyzing this information. Technically-based cooperative monitoring can provide an objective source of information on mutually agreed issues, thereby supporting the implementation of confidence building measures and treaties. In addition, technology itself can be a neutral subject of interaction and collaboration between technical communities from different countries. Establishing a CPC in Northeast Asia does not require the existence of an Asian security regime. Indeed, activities that occur under the auspices of a CPC, even highly formalized exchanges of agreed information, can increase transparency, and thereby pave the way for future regional cooperation. Major players in Northeast Asian security are Japan, Russia, China, North and South Korea, and the United States.

346 (SAND–94-1530C) **Free-field seismic ground motion in non-proliferation experiment.** Garbin, H.G. Sandia National Labs., Albuquerque, NM (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9404100–7: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94013778. Source: OSTI; NTIS; GPO Dep.

In addition to stress and acceleration measurements made in the inelastic regime, Sandia fielded two triaxial accelerometer packages in the seismic free-field for the NON-PROLIFERATION EXPERIMENT (NPE). The gauges were located at ranges of 190 and 200 m from the center of the ANFO-laden cavity on the opposite sides of a vertical fault. This location allowed us to assess several different seismological aspects related to non-proliferation. The radial and vertical components of the two packages show similar motion. Comparisons are made with similar data from nuclear tests to estimate yield, calculate seismic energy release and to detect spectral differences between nuclear and non-nuclear explosions. The wave forms of NPE differ significantly from nuclear explosions. The first two peak amplitudes of NPE are comparable while the nuclear explosion initial peak is much larger than the second peak. The calculated seismic energies imply that the conventional explosions couple to the medium much better at low frequencies than do nuclear explosions and that nuclear explosions contain more high frequency energy than NPE. Radial and vertical accelerations were integrated for displacement and indicate there was movement across the fault.

347 (SAND–94-1531C) **Yield of the Non-Proliferation Experiment from the Leo Brady Seismic Net.** Garbin, H.D. Sandia National Labs., Albuquerque, NM (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9404100–6: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94013777. Source: OSTI; NTIS; INIS; GPO Dep.

The Leo Brady Seismic Net (LBSN) has been used to estimate seismic yields on US nuclear explosion tests for over 30 years. One of the concerns that Non-Proliferation Experiment (NPE) addresses is the yield equivalence between a large conventional explosion and a nuclear explosion. The LSBN consists of five stations that surround the Nevada Test Site (NTS). Because of our previous experience in measuring nuclear explosion yields, we operated this net to record NPE signals. Comparisons were made with 9 nuclear tests in the same volcanic tuff medium and within an 800 m range of the NPE source. The resulting seismic yield determined by each nuclear test ranged from 1.3 to 2.2 kT. Using the same techniques in determining nuclear explosion yields, the 1 kT NPE was measured at 1.7 kT nuclear equivalent yield with a standard deviation of 16%. The individual stations show a non-symmetric radiation pattern with more energy transmitted to the north and south. Comparisons with an nuclear event does not sow any obvious differences between the two tests.

348 (SAND–94-1817C) **Thermal design of the fast-on-orbit recording of transient events (FORTE) satellite.** Akau, R.L. (Sandia National Labs., Albuquerque, NM (United States)); Behr, V.L.; Whitaker, R. Sandia National Labs., Albuquerque, NM (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract AC04-94AL85000. (CONF-9408132–3: AIAA small satellite conference, Logan, UT (United States), 29 Aug - 1 sep 1994). Order Number DE95001621. Source: OSTI; NTIS; GPO Dep.

Analytical tools were used to design a thermal control system for the FORTE satellite. An overall spacecraft thermal model was developed to provide boundary temperatures for detailed thermal models of the FORTE instruments. The thermal design will be presented and thermal model results discussed.

349 (SAND–94-1895C) **Design and implementation of a Synthetic Aperture Radar for Open Skies (SAROS) aboard a C-135 aircraft.** Cooper, D.W. (Sandia National Labs., Albuquerque, NM (United States)); Murphy, M.; Rimmel, G. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9410160–1: Antenna Measurement Techniques Association symposium, Long Beach, CA (United States), 3-7 Oct 1994). Order Number DE94015767. Source: OSTI; NTIS; GPO Dep.

NATO and former Warsaw Pact nations have agreed to allow overflights of their countries in the interest of easing world tension. The United States has decided to implement two C-135 aircraft with a Synthetic Aperture Radar (SAR) that has a 3-meter resolution. This work is being sponsored by the Defense Nuclear Agency (DNA) and will be operational in Fall 1995. Since the SAR equipment must be exportable to foreign nations, a 20-year-old UPD-8 analog SAR system was selected as the front-end and refurbished for this application by Loral Defense Systems. Data processing is being upgraded to a currently exportable digital design by Sandia National Laboratories. Amplitude and phase histories will be collected during these overflights and digitized on VHS cassettes. Ground stations will use reduction algorithms to process the data and convert it to magnitude-detected images for member nations. System Planning Corporation is presently developing a portable ground station for use on the demonstration flights. Aircraft integration into the C-135 aircraft is being done by the Air Force at Wright-Patterson AFB, Ohio.

350 (SAND–94-2377C) **Application of a satellite communication and location system for bomb damage assessment.** Kern, J.P. Sandia National Labs., Albuquerque, NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9409216–1: Precision strike technology symposium, Laurel, MD (United States), 27-29 Sep 1994). Order Number DE94019308. Source: OSTI; NTIS; GPO Dep.

The Global Verification and Location System (GVLS) is a satellite based communication package proposed for the Global Positioning System (GPS) Block IIR satellites. This system provides the capability to relay bursts of information from small, low power mobile transmitters to command and control facilities. Communication paths through multiple GPS satellites within the field of view allow location of the transmitter using time difference of arrival (TDOA) techniques. Alternately, the transmitter can transmit its own location if known by various other means. Intended applications include determination of the status and location of high-valued assets such as shipments of proliferation-sensitive nuclear materials and treaty-limited items or downed air crews and special operations forces in need of extraction from hostile territory. GVLS provides an enabling technology which can be applied to weapon impact location. The remote transmitter is small and light enough to be integrated into a weapon delivery vehicle, such as a cruise missile, and requires power only during the last second of flight. The antenna is a conformal patch design, therefore minimizing aerodynamic considerations. Precise impact locations are determined by the GVLS system and can be communicated to responsible commands in near real time allowing rapid bomb damage assessment and retargeting without the typical delays of overhead reconnaissance. Since burst data communication is used, weapon status immediately prior to impact can be transmitted providing knowledge of proper arming sequence and other pertinent information. If desired, periodic bursts can be transmitted while in flight, enabling in-course tracking of the weapon. If fully deployed, the GVLS system would consist of communication relays on 24 GPS satellites, five ground stations deployed worldwide, and portable base stations for authorized users to receive and display locations and contents of their transmissions.

351 (SAND–94-2474) **Soil-penetrating synthetic aperture radar.** Boverie, B.; Brock, B.C.; Doerry, A.W. Sandia National Labs., Albuquerque, NM (United States). Dec 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE95007719. Source: OSTI; NTIS; GPO Dep.

This report summarizes the results for the first year of a two year Laboratory Directed Research and Development (LDRD) effort. This effort included a system study, preliminary data acquisition, and preliminary algorithm development. The system study determined the optimum frequency and bandwidth, surveyed soil parameters and targets, and defined radar cross section in lossy media. The data acquisition imaged buried objects with a rail-SAR. Algorithm development included a radar echo model, three-dimensional processing, sidelobe optimization, phase history data interpolation, and clutter estimation/cancellation.

352 (SAND–94-8230) **Elemental and isotopic ion beam analysis of micron-scale uranium particles.** Morse, D.H. (Sandia National Labs., Livermore, CA (United States)); Pontau, A.E.; Antolak, A.J.; Bench, G.S.; Heikkinen, D.W. Sandia National Labs., Livermore, CA (United States). Apr 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Source: OSTI.

The feasibility of using high energy, micron-scale ion beams to determine the elemental and isotopic composition of micron-scale particles is explored in support of nuclear nonproliferation efforts. Scanning PIXE analysis is demonstrated to be an effective method of locating particles of interest on a filter paper or other collection media. Rutherford backscattering and Coulomb excitation are both examined as possible techniques for characterizing the isotopic ratios of uranium particles. Experimental results are presented comparing the effects of ion species, beam energy, and other parameters on all three techniques. Emphasis is placed on the characteristics of each technique that would affect its use in a practical system, including spatial resolution, detection sensitivity, speed of analysis, element or isotope resolution and the existence of interfering

signals or ambiguous results. The effects of beam damage are also considered.

353 (SFB-303-DP-B–288) **How (not) to sell nuclear weapons.** Jehiel, P.; Moldovanu, B.; Stacchetti, E. Bonn Univ. (Germany). Sonderforschungsbereich 303 - Information und die Koordination Wirtschaftlicher Aktivitaeten. Jan 1994. 16p. Source: Available from TIB Hannover: RO 3009(288).

We study the problem of a seller who wants to maximize her revenue in situations where the outcome of the sale affects the nature of the future interaction between agents. We model those situations by assuming that an agent that does not acquire the object for sale incurs an externality that may depend both on the identity of the sufferer and on the identity of the final purchaser. We describe an optimal auction that has a unique Nash equilibrium in strictly dominant strategies. We show that: (1) Outside options are endogenously determined in equilibrium. Participation constraints and the "threats" in case of non-participation play an important role. (2) An optimizing seller can extract surplus also from buyers that do not obtain the auctioned object. (3) The seller is better off by not selling at all (while obtaining some payments) if externalities are large when compared to the pure profits that buyers achieve if they acquire the object. (4) The revenue-maximizing equilibrium is coalition-proof if buyers cannot organize side payments among themselves. (orig.)

354 (UCRL–52000-94-3) **Energy & Technology Review, March 1994.** Quirk, W.J.; Canada, J.; de Vore, L.; Gleason, K.; Kirvel, R.D.; Kroopnick, H.; McElroy, L.; Van Dyke, P. (eds.). Lawrence Livermore National Lab., CA (United States). Mar 1994. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94010367. Source: OSTI; NTIS; GPO Dep.

This monthly report of research activities at Lawrence Livermore Laboratory highlights three different research programs. First, the Forensic Science Center supports a broad range of analytical techniques that focus on detecting and analyzing chemical, biological, and nuclear species. Analyses are useful in the areas of nonproliferation, counterterrorism, and law enforcement. Second, starting in 1977, the laboratory initiated a series of studies to understand a high incidence of melanoma among employees. Continued study shows that mortality from this disease has decreased from the levels seen in the 1980's. Third, to help coordinate the laboratory's diverse research projects that can provide better healthcare tools to the public, the lab is creating the new Center for Healthcare Technologies.

355 (UCRL-CR–116651) **A study of small explosions and earthquakes during 1961–1989 near the Semipalatinsk Test Site, Kazakhstan.** Khalturin, V.I. (Russian Academy of Sciences, Moscow (Russian Federation). Inst. of Physics of the Earth); Rautian, T.G.; Richards, P.G. Lawrence Livermore National Lab., CA (United States). Mar 1994. 64p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. DOD Grant F49620-92-J-0497. Order Number DE95005994. Source: OSTI; NTIS; INIS; GPO Dep.

Several Russian sources have stated that 343 underground nuclear explosions were conducted during 1961–1989 at the Semipalatinsk Test Site. However, only 282 of them appear to have been described, in the openly available technical literature, with well-determined coordinates; and only 272 have both good locations and magnitudes. The authors have used regional data from 52 stations to study 65 seismic sources initially thought to be in or near the Semipalatinsk region, additional to the 272 underground nuclear explosions with known locations and magnitudes. Of these 65 events, the authors believe 8 are not explosions on the test site, namely: two earthquakes close to the test site; three earthquakes or chemical explosions 100–300 km from the test site; and three events at greater distances from Semipalatinsk. Of the remaining 57 events: 10 were known to be underground nuclear explosions with known locations and the authors have supplied magnitudes where none were previously available; one was a chemical explosion at Degelen; they believe 21 were underground nuclear explosions; 13 were chemical explosions at Balapan; 8 were chemical explosions elsewhere on the test site; three were either nuclear or chemical explosions; and one was either a chemical explosion or a cavity collapse. The largest magnitude of their 44 possible underground nuclear explosions is around 5 (February 4, 1965, obscured at many teleseismic stations by a large Aleutian earthquake). Others lie in the magnitude range 3.5–4.5, and clearly most have sub kiloton yields. Their data set of small events is important for purposes of evaluating the detection capability of teleseismic arrays, and the detection and identification capability of regional stations.

356 (UCRL-CR–117755) **Direct calibration of the yield of nuclear explosion.** Nakanishi, K. (SYNAPSE Science Center/Moscow IRIS Data Analysis Center, Moscow (Russian Federation)); Nikolayev, A. Lawrence Livermore National Lab., CA (United States); SYNAPSE Science Center/Moscow IRIS Data Analysis Center, Moscow (Russian Federation). Jun 1994. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE95004969. Source: OSTI; NTIS; INIS; GPO Dep.

The determination of the power of underground nuclear explosions (UNE) is of great significance. The seismic method of UNE yield determination allows monitoring at large distances, but is less precise than local monitoring methods. A way is proposed to calibrate UNE based on the idea of the vibroseis method in which powerful vibrators are used to produce seismic waves in the UNE epicenter; UNE calibration is carried out by comparison of the vibroseis record with a UNE seismogram. Results of preliminary work on the problem are presented. It is based on experience with vibrosounding of the Earth as well as earthquakes and chemical and nuclear explosions wave field structure studies. It is concluded that UNE calibration with the aid of seismic vibrators is both possible and expedient.

357 (UCRL-ID–116110) **Location capability of a sparse regional network (RSTN) using a multi-phase earthquake location algorithm (REGLOC).** Hutchings, L. Lawrence Livermore National Lab., CA (United States). Jan 1994. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94007848. Source: OSTI; NTIS; GPO Dep.

The Regional Seismic Test Network (RSTN) was deployed by the US Department of Energy (DOE) to determine whether data recorded by a regional network could be used

to detect and accurately locate seismic events that might be clandestine nuclear tests. The purpose of this paper is to evaluate the location capability of the RSTN. A major part of this project was the development of the location algorithm REGLOC and application of Basian a prior statistics for determining the accuracy of the location estimates. REGLOC utilizes all identifiable phases, including backazimuth, in the location. Ninty-four events, distributed throughout the network area, detected by both the RSTN and located by local networks were used in the study. The location capability of the RSTN was evaluated by estimating the location accuracy, error ellipse accuracy, and the percentage of events that could be located, as a function of magnitude. The location accuracy was verified by comparing the RSTN results for the 94 events with published locations based on data from the local networks. The error ellipse accuracy was evaluated by determining whether the error ellipse includes the actual location. The percentage of events located was assessed by combining detection capability with location capability to determine the percentage of events that could be located within the study area. Events were located with both an average crustal model for the entire region, and with regional velocity models along with station corrections obtained from master events. Most events with a magnitude <3.0 can only be located with arrivals from one station. Their average location errors are 453 and 414 km for the average- and regional-velocity model locations, respectively. Single station locations are very unreliable because they depend on accurate backazimuth estimates, and backazimuth proved to be a very unreliable computation.

358 (UCRL-ID–116123) **Rockbursts as opportunities for the concealment of nuclear tests?.** Heuze, F.E. Lawrence Livermore National Lab., CA (United States). Jan 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94007849. Source: OSTI; NTIS; GPO Dep.

Based on a review of the engineering and scientific literature from 1979 to 1993 concerning mine rockbursts, it is concluded that the hiding of nuclear tests in rockbursts is a highly improbable scenario. This is due to the lack of ability for anyone to accurately predict the time and location of occurrence of natural rockbursts, in spite of active research on the subject. However, such an evasion scheme is not impossible. A contrived rockburst possibly could be made to happen in a somewhat "controlled" fashion. This rather farfetched scenario is outlined in the discussion. Such an event most likely would involve serious damage to the underground, and would be unlikely to be repeated frequently at any given site. Moreover, it would be extremely difficult to control its seismic magnitude.

359 (UCRL-ID–116130) **Seismic event interpretation using fuzzy logic and neural networks.** Maurer, W.J.; Dowla, F.U. Lawrence Livermore National Lab., CA (United States). Jan 1994. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94009469. Source: OSTI; NTIS; GPO Dep.

In the computer interpretation of seismic data, unknown sources of seismic events must be represented and reasoned about using measurements from the recorded signal. In this report, we develop the use of fuzzy logic to improve our ability to interpret weak seismic events. Processing strategies for the use of fuzzy set theory to represent vagueness and uncertainty, a phenomena common in seismic data analysis, are developed. A fuzzy-assumption based truth-maintenance-inferencing engine is also developed. Preliminary results in interpreting seismic events using the fuzzy neural network knowledge-based system are presented.

360 (UCRL-ID–116170) **Reactor options for disposition of excess weapon plutonium: Selection criteria and decision process for assessment.** Edmunds, T.; Buonpane, L.; Sicherman, A.; Sutcliffe, W.; Walter, C.; Holman, G. Lawrence Livermore National Lab., CA (United States). Jan 1994. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94011539. Source: OSTI; NTIS; GPO Dep.

DOE is currently considering a wide range of alternatives for disposition of excess weapon plutonium, including using plutonium in mixed oxide fuel for light water reactors (LWRs). Lawrence Livermore National Laboratory (LLNL) has been tasked to assist DOE in its efforts to develop a decision process and criteria for evaluating the technologies and reactor designs that have been proposed for the fission disposition alternative. This report outlines an approach for establishing such a decision process and selection criteria. The approach includes the capability to address multiple, sometimes conflicting, objectives, and to incorporate the impact of uncertainty. The approach has a firm theoretical foundation and similar approaches have been used successfully by private industry, DOE, and other government agencies to support and document complex, high impact technology choice decisions. Because of their similarity and relatively simple technology, this report focuses on three light water reactors studied in Phase 1 of the DOE Plutonium Disposition Study. The decision process can be extended to allow evaluation of other reactor technologies and disposition options such as direct disposal and retrievable storage.

361 (UCRL-ID–116207) **A simple method for rapidly processing HEU from weapons returns.** McLean, W. II; Miller, P.E. Lawrence Livermore National Lab., CA (United States). Jan 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94008308. Source: OSTI; NTIS; GPO Dep.

A method based on the use of a high temperature fluidized bed for rapidly oxidizing, homogenizing and downblending Highly Enriched Uranium (HEU) from dismantled nuclear weapons is presented. This technology directly addresses many of the most important issues that inhibit progress in international commerce in HEU; viz., transaction verification, materials accountability, transportation and environmental safety. The equipment used to carry out the oxidation and blending is simple, inexpensive and highly portable. Mobile facilities to be used for point-of-sale blending and analysis of the product material are presented along with a phased implementation plan that addresses the conversion of HEU derived from domestic weapons and related waste streams as well as material from possible foreign sources such as South Africa or the former Soviet Union.

362 (UCRL-ID–116980) **Seismic source-region elastic calculations on KDYNA.** Clarke, D.B. Lawrence Livermore National Lab., CA (United States). Mar 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94017490. Source: OSTI; NTIS; INIS; GPO Dep.

This paper summarizes the results of source-region simulations on the KDYNA hydrodynamics code. The source was a pressure-step function in a 40-m-radius cavity 500 m below a free surface. The problem of a driven cavity in an elastic material was chosen as a test and calibration problem for two reasons. First, the driven cavity is a model for an underground explosion. Secondly, the availability of analytical methods for waves in elastic solids means that alternate calculational paths exist for calculating the distant signals from the cavity. Data from an array of sensor points roughly 1 km from the source were saved and passed to Howard Patton and Keith K. Nakanish for input to a NMTS (Normal Mode Time Series) code. The data consisted of the time histories (0 to 2 s) of the radial and axial velocities and the radial, axial, and shear components of the stress at each sensor point. The NMTS code will use the input to predict the signals in the far field (e.g., 300 km) from the explosion source. This elastic KDYNA calculation provides a complete and satisfactory simulation for input to the NMTS code and for comparison with other calculational methods.

363 (UCRL-ID–117010) **Recovery of weapon plutonium as feed material for reactor fuel.** Armantrout, G.A. (and others); Bronson, M.A.; Choi, Jor-Shan. Lawrence Livermore National Lab., CA (United States). 16 Mar 1994. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94009977. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents preliminary considerations for recovering and converting weapon plutonium from various US weapon forms into feed material for fabrication of reactor fuel elements. An ongoing DOE study addresses the disposition of excess weapon plutonium through its use as fuel for nuclear power reactors and subsequent disposal as spent fuel. The spent fuel would have characteristics similar to those of commercial power spent fuel and could be similarly disposed of in a geologic repository.

364 (UCRL-ID–117293) **CTBT technical issues handbook.** Zucca, J.J. (ed.). Lawrence Livermore National Lab., CA (United States). May 1994. 95p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE95002595. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this handbook is to give the nonspecialist in nuclear explosion physics and nuclear test monitoring an introduction to the topic as it pertains to a Comprehensive Test Ban Treaty (CTBT). The authors have tried to make the handbook visually oriented, with figures paired to short discussions. As such, the handbook may be read straight through or in sections. The handbook covers four main areas and ends with a glossary, which includes both scientific terms and acronyms likely to be encountered during CTBT negotiations. The following topics are covered: (1) Physics of nuclear explosion experiments. This is a description of basic nuclear physics and elementary nuclear weapon design. Also discussed are testing practices. (2) Other nuclear experiments. This section discusses experiments that produce small amounts of nuclear energy but differ from explosion experiments discussed in the first chapter. This includes the type of activities, such as laser fusion, that would continue after a CTBT is in force. (3) Monitoring tests in various environments. This section describes the different physical environments in which a test could be conducted (underground, in the atmosphere, in space, underwater, and in the laboratory); the sources of non-nuclear events (such as earthquakes and mining operations); and the opportunities for evasion. (4) On-site inspections. A CTBT is likely to include these inspections as an element of the verification provisions, in order to resolve the nature of ambiguous events. This chapter describes some technical considerations and technologies that are likely to be useful. (5) Selecting verification measures. This chapter discusses the uncertain nature of the evidence from monitoring systems and how compliance judgments could be made, taking the uncertainties into account. It also discusses how to allocate monitoring resources, given the likelihood of testing by various countries in various environments.

365 (UCRL-ID–118389) **Laser Weapons Testing Treaty Monitoring (LAWTTM): A final report of the Lawrence Livermore National Laboratory portion of the investigation.** Blum, A.; Jones, D. Lawrence Livermore National Lab., CA (United States). Aug 1994. 101p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE95009381. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The LAWTTM program examined the effectiveness of monitoring the laser emissions from a test facility by using fence-line-mounted detectors and cameras for the purpose of treaty verification. Argonne National Laboratory (ANL), Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), and Sandia National Laboratory (SNL) collaborated in the evaluation of several approaches to the problem. LLNL fielded a two-camera system based on infrared focal plane array technology. The cameras formed images of the laser beam from the light that was scattered as the beam passed through the atmosphere. The hardware and data-reduction software were used to determine the beam trajectory, energy, and approximate width of a 1.053-μm Nd:Glass laser at a site provided by SNL. This report describes the LLNL hardware, data-reduction procedures, and the LLNL data from the March 1993 field experiments at SNL. The data are used to construct a model that predicts detection performance at other laser wavelengths and with various optical-filter bandwidths. During the March 1993 field experiments, the typical 90-J laser beam was easily detected with a large signal-to-noise (S/N) ratio, and the occasional 29-J shots that arose because of laser-amplifier malfunctions were also detected, but with a marginal S/N ratio. The capture of the scattered laser light depends largely on the clarity of the atmosphere and the bandwidth of the optical filters.

366 (UCRL-JC–116124) **Investigation of the ocean acoustic signatures from strong explosions at a long distance in the ocean sound channel by computer simulation.** Kamegai, M.; White, J.W.; Clarke, D.B. Lawrence Livermore National Lab., CA (United States). May 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9406217–1: 127. Acoustical Society of America conference, Cambridge, MA (United States), 6-10 Jun 1994). Order Number DE94015455. Source: OSTI; NTIS; GPO Dep.

The principal objective of the non-proliferation program is to discourage clandestine testing of nuclear explosives by maintaining an effective global surveillance system. The methods of detection include underwater and atmospheric

acoustics, seismology and atmospheric photometry. The goals of the underwater acoustics are the identification and location of ocean acoustic signatures. The investigation is directed toward obtaining t quantitative correlation between the initial explosion source under various conditions and the final acoustical signatures received at a great distance for different paths. By computer simulations, we calculated the energy coupling and dissipation in the water and studied the signature patterns. In this paper, we report preliminary results of the study on the signals from 1 kt explosions after the signals have propagated a significant distance in the SOFAR channel. The third step in the model has not yet been addressed.

367 (UCRL-JC-116224) **Deterrence, denuclearization, and proliferation: Alternative visions of the next fifty years.** Lehman, R.F. II. Lawrence Livermore National Lab., CA (United States). 12 Feb 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9310320--1: Joint Indo-US seminar on nonproliferation and technology transfer center for the advanced study of India, Philadelphia, PA (United States), 3-6 Oct 1993). Order Number DE94010901. Source: OSTI; NTIS; INIS; GPO Dep.

The great library of Alexandria may have contained fewer volumes than the number which have been written on the subject of nuclear weapons in the Cold War. With the end of the Cold War, a new nuclear library is in the making. Much thought is being given to the next steps in nuclear policy, strategy, forces, arms control, and nonproliferation. For this very distinguished conference, however, I have been asked to look further ahead indeed, forward fifty-years. Prognostication is always a risky business. Detailed predictions beyond the shortest duration are difficult to label as "scientific" even in the social sciences. Forecasting ahead fifty years in an age of ever accelerating change would seem to be hopeless. Projecting the future of nuclear weapons, however, may not be as complex as one might think. Detailing the future fifty years from now is not necessary. We want to inform upcoming decisions by examining the possibilities, not write a history in advance of what is to happen. Our look forward con benefit from a brief look back fifty years. In retrospect, those years passed quickly, and with each additional year, analysts make them appear more simple than they seemed at the time. This paper contributes further to this process of oversimplification, as we say, "for heuristic purposes." When in doubt, I have erred on the side of being provocative.

368 (UCRL-JC-116387) **A gamma-ray verification system for special nuclear material.** Lanier, R.G.; Prindle, A.L.; Friensehner, A.V.; Buckley, W.M. Lawrence Livermore National Lab., CA (United States). Jul 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940748--79: 35. annual meeting of the Institute of Nuclear Materials Management (INMM), Naples, FL (United States), 17-20 Jul 1994). Order Number DE94016609. Source: OSTI; NTIS; GPO Dep.

The Safeguards Technology Program at the Lawrence Livermore National Laboratory (LLNL) has developed a gamma-ray screening system for use by the Materials Management Section of the Engineering Sciences Division at LLNL for verifying the presence or absence of special nuclear material (SNM) in a sample. This system facilitates the measurements required under the "5610" series of US Department of Energy orders. MMGAM is an intelligent, menu driven software application that runs on a personal computer and requires a precalibrated multi-channel analyzer and HPGe detector. It provides a very quick and easy-to-use means of determining the presence of SNM in a sample. After guiding the operator through a menu driven set-up procedure, the system provides an on-screen GO/NO-GO indication after determining the system calibration status. This system represents advances over earlier used systems in the areas of ease-of use, operator training requirements, and quality assurance. The system records the gamma radiation from a sample using a sequence of measurements involving a background measurement followed immediately by a measurement of the unknown sample. Both spectra are stored and available for analysis or output. In the current application, the presence of ^{235}U, ^{238}U, ^{239}Pu, and ^{208}Tl isotopes are indicated by extracting, from the stored spectra, four energy "windows" preset around gamma-ray lines characteristic of the radioactive decay of these nuclides. The system is easily extendible to more complicated problems.

369 (UCRL-JC-116428) **The influence of material models on chemical or nuclear-explosion source functions.** Glenn, L.A.; Goldstein, P. Lawrence Livermore National Lab., CA (United States). Apr 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9404100--8: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94014739. Source: OSTI; NTIS; GPO Dep.

Physical models of explosion sources are needed to explain the variations in the performance of existing discriminants in different regions, and to help develop more robust methods for identifying underground explosions. In this paper, we assess the sensitivity of explosion source functions to material properties by means of numerical simulations. Specifically, we have calculated the effect of varying the yield strength, overburden pressure, and gas porosity on the spectra of the reduced velocity potential for both nuclear and chemical explosions, and compared these with experimental results derived from free-field particle acceleration and regional seismic (LNN) data. The chemical-explosion calculations were intended to simulate the kiloton experiment recently conducted in Area 12 of the Nevada Test Site (NTS) that has been dubbed the Non-Proliferation Experiment (NPE). We found that the asymptotic (long period) value of the reduced displacement potential, $\phi\infty$, for explosions with the ANFO blasting agent used in the NPE, was larger than that derived for a tamped nuclear explosion of the same yield by a factor of 1.9, in good agreement with the experimental results derived from free-field particle velocity measurements, and also with $m_b(P_n)$ data from the Livermore Nevada Network (LNN).

370 (UCRL-JC-116990) **Workshop on arms control and security in the Middle East II summary report.** Chrzanowski, P.L. Lawrence Livermore National Lab., CA (United States). ©Apr 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940193--Summ.: Workshop on arms control and security in the Middle East, Delphi (Greece), 3-7

Jan 1994). Source: Institute on Global Conflict and Cooperation, Univ. of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0518.

Policy Paper No. 7.

The Middle East peace process is now moving more rapidly than ever before. Many actors in the region have displayed a newfound willingness to adopt innovative approaches to resolving persistent conflicts. The end of the Cold War, the accord signed between Israel and the PLO in September 1993, and other recent hopeful developments in the bilateral and multilateral talks have opened the door to real progress in regional security and arms control. The door may quickly shut, however, if promising signs are not translated into concrete, practical, and verifiable agreements. To complement the ongoing negotiations and help sustain the momentum of the Middle East peace process, the Institute on Global Conflict and Cooperation (IGCC) and the Institute of International Relations, co-sponsored a Workshop on Arms Control and Security in the Middle East in Delphi, Greece, in January 1994. Participants in the Delphi workshop were current and former government officials, veteran arms control negotiators, military officers, and leading nongovernmental specialists on arms control and regional security issues from Arab states, Israel, the United States, Europe, and Russia. To facilitate frank discussions and the free exchange of ideas, the conference was held in a private, informal setting, and all discussions at the meeting were off the record. The workshop gave Arab and Israeli participants an opportunity to draw upon the expertise that American, European, and Russian experts have gained through research and development efforts and negotiations between and within governments on arms control issues. At the same time, Arab and Israeli experts voiced their ideas, perspectives, and concerns to each other and to the participants from outside the Middle East. This report summarizes the main points of agreement and the major areas of controversy that came to the fore at the Delphi conference.

371 (UCRL-JC--117385) **Achieving competitive excellence in nuclear energy: The threat of proliferation; the challenge of inertial confinement fusion.** Nuckolls, J.H. Lawrence Livermore National Lab., CA (United States). Jun 1994. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940602--17: 35. annual meeting of the American Nuclear Society, New Orleans, LA (United States), 11-16 Jun 1994). Order Number DE94016452. Source: OSTI; NTIS; INIS; GPO Dep.

Nuclear energy will have an expanding role in meeting the twenty-first-century challenges of population and economic growth, energy demand, and global warming. These great challenges are non-linearly coupled and incompletely understood. In the complex global system, achieving competitive excellence for nuclear energy is a multi-dimensional challenge. The growth of nuclear energy will be driven by its margin of economic advantage, as well as by threats to energy security and by growing evidence of global warming. At the same time, the deployment of nuclear energy will be inhibited by concerns about nuclear weapons proliferation, nuclear waste and nuclear reactor safety. These drivers and inhibitors are coupled: for example, in the foreseeable future, proliferation in the Middle East may undermine energy security and increase demand for nuclear energy. The Department of Energy's nuclear weapons laboratories are addressing many of these challenges, including nuclear weapons builddown and nonproliferation, nuclear waste storage and burnup, reactor safety and fuel enrichment, global warming, and the long-range development of fusion energy. Today I will focus on two major program areas at the Lawrence Livermore National Laboratory (LLNL): the proliferation of nuclear weapons and the development of inertial confinement fusion (ICF) energy.

372 (UCRL-JC--117752) **The non-proliferation experiment and gas sampling as an on-site inspection activity: A progress report.** Carrigan, C.R. Lawrence Livermore National Lab., CA (United States). Mar 1994. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9404100--11: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94017546. Source: OSTI; NTIS; INIS; GPO Dep.

The Non-proliferation Experiment (NPE) is contributing to the development of gas sampling methods and models that may be incorporated into future on-site inspection (OSI) activities. Surface gas sampling and analysis, motivated by nuclear test containment studies, have already demonstrated the tendency for the gaseous products of an underground nuclear test to flow hundreds of meters to the surface over periods ranging from days to months. Even in the presence of a uniform sinusoidal pressure variation, there will be a net flow of cavity gas toward the surface. To test this barometric pumping effect at Rainier Mesa, gas bottles containing sulfur hexaflouride and ^{3}He were added to the pre-detonation cavity for the 1 kt chemical explosives test. Pre-detonation measurements of the background levels of both gases were obtained at selected sites on top of the mesa. The background levels of both tracers were found to be at or below mass spectrographic/gas chromatographic sensitivity thresholds in the parts-per-trillion range. Post-detonation, gas chromatographic analyses of samples taken during barometric pressure lows from the sampling sites on the mesa indicate the presence of significant levels (300–600 ppt) of sulfur hexaflouride. However, mass spectrographic analyses of gas samples taken to date do not show the presence of ^{3}He. To explain these observations, several possibilities are being explored through additional sampling/analysis and numerical modeling. For the NPE, the detonation point was approximately 400 m beneath the surface of Rainier Mesa and the event did not produce significant fracturing or subsidence on the surface of the mesa. Thus, the NPE may ultimately represent an extreme, but useful example for the application and tuning of cavity gas detection techniques.

373 (UCRL-JC--117754) **Comparison of the non-proliferation event aftershocks with other Nevada Test Site events.** Jarpe, S.; Goldstein, P.; Zucca, J.J. Lawrence Livermore National Lab., CA (United States). Apr 1994. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9404100--12: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94018071. Source: OSTI; NTIS; INIS; GPO Dep.

As part of a larger effort to develop technology for on-site inspection of ambiguous underground seismic events, we have been working to identify phenomenology of aftershock

seismicity which would be useful for discriminating between nuclear explosions, chemical explosions, earthquakes or other seismic events. Phenomenology we have investigated includes; the spatial distribution of aftershocks, the number of aftershocks as a function of time after the main event, the size of the aftershocks, and waveform frequency content. Our major conclusions are: (1) Depending on local geologic conditions, aftershock production rate two weeks after zero time ranges from 1 to 100 per day. (2) Aftershocks of concentrated chemical explosions such as the NPE are indistinguishable from aftershocks of nuclear explosions. (3) Earthquake and explosion aftershock sequences may be differentiated on the basis of depth, magnitude, and in some cases, frequency content of seismic signals.

374 (UCRL-JC–117776) **Shielding requirements for the transport of nuclear warhead components under decommissioning.** Hansen, L.F. Lawrence Livermore National Lab., CA (United States). Sep 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9409188–3: 6. Russian scientific conference on radiation shielding of nuclear installations, Obninsk (Russian Federation), 20-23 Sep 1994). Order Number DE95008379. Source: OSTI; NTIS; INIS; GPO Dep.

The requirements to carry out accurate shielding calculations involved with the safe off-site transportation of packages containing nuclear warhead components, special assemblies and radioactive materials are discussed. The need for (a) detailed information on the geometry and material composition of the packaging and radioactive load, (b) accurate representation of the differential energy spectra (dN/dE) for the neutron and gamma spectra emitted by the radioactive materials enclosed in the packaging, (c) well-tested neutron and photon cross section libraries, (d) and accurate three-dimensional Monte Carlo transport codes are illustrated. A brief discussion of the need for reliable dose measurements is presented.

375 (UCRL-JC–117888) **Trends and challenges in global arms control regimes: Implications for the Mediterranean, North Africa, and the Middle East.** Lehman, R.F. II. Lawrence Livermore National Lab., CA (United States). Jun 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9406251–1: International workshop arms control, confidence building and security cooperation in the Mediterranean, North Africa and the Middle East, Valletta (Malta), 25 Jun 1994). Order Number DE94018336. Source: OSTI; NTIS; GPO Dep.

In another sense, however, the nuclear age and ballistic missiles long ago created a much smaller world in which the distinctions between global and regional security have been lessened. In an age of weapons of mass destruction, any point on the earth can find itself suddenly at the center of world attention. This makes it all the more important that we understand all of the arms control tools available, including global approaches. In discussing global arms control regimes, I will focus primarily on those that are open to universal membership such as the Nuclear Nonproliferation Treaty (NPT) or which have global reach, such as certain export control and supplier regimes. It is important to remember, however, that certain regional, bilateral, and even unilateral arms control measures can have a global impact as well. One need only witness the impact of the Treaty on Conventional Forces in Europe (CFE). Despite its mere "Atlantic to the Urals" focus, the CFE treaty helped change the political and strategic calculations of the entire world. Likewise, the Conference on Security and Cooperation in Europe (CSCE), with its headquarters in Vienna, is centered on Europe but spreads from Vancouver to Vladivostok (or perhaps we should say from Amchitka to Kamchatka), circumnavigating much of the northern hemisphere when measured the long way around via North America. The political significance of its successes and failures outdistance CSCE's geographical spread.

376 (UCRL-JC–118159) **Statement by Dr. Kathleen C. Bailey before the Senate Armed Services Committee.** Bailey, K.C. Lawrence Livermore National Lab., CA (United States). 16 Aug 1994. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9408172–1: Senate Armed Services committee meeting, Washington, DC (United States), 18 Aug 1994). Order Number DE95000556. Source: OSTI; NTIS; GPO Dep.

This paper presents the personal views of the author on the subject of the proposed Chemical Weapons Convention (CWC). She addresses here concerns about the national security issues which could result from ratification of this convention. She argues the convention alone is not likely to curtail production or availability of such items on the world market because of the relatively low cost. The treaty could thus put the country in a position less likely to protect itself, or adequately deal with such a threat.

377 (UCRL-JC–118747) **Technical potential for proliferation in Northeast Asian states.** Joeck, N. (Lawrence Livermore National Lab., CA (United States). Directorate for Nonproliferation, Arms Control, and International Security); Kramer, R. Lawrence Livermore National Lab., CA (United States). 14 Oct 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9405313–1: United Nation Institute for Disarmament Research (UNIDIR) international conference on nuclear policies in Northeast Asia, Seoul (Korea, Republic of), 25-27 May 1994). Order Number DE95010800. Source: OSTI; NTIS; GPO Dep.

This paper is intended to review the technical capabilities of the states in Northeast Asia–principally Japan, South Korea, and North Korea–to develop nuclear weapons. All three nonnuclear weapons states in Northeast Asia have the technical capability to develop nuclear weapons. Japan and South Korea have intrusive safeguards and inspection arrangements on their nuclear programs, which allow their neighbors and the rest of the world to verify that they have not changed that status, and that they are living up to their NPT commitments. Despite its original commitment to the NPT, North Korea has yet to establish similar arrangements. it is ironic that the country with the smallest and technically least sophisticated nuclear program is the one creating the greatest concern about nuclear proliferation in the region. This irony illustrates the point made in the introduction, however. Nuclear proliferation is more a function of political decisionmaking than of technical capability.

378 (UCRL-JC–118760) **The Cooperative On-site Sampling and Analysis Experiment (COSAX).** McGuire, R.R. (Lawrence Livermore National Lab., CA (United States). Arms Control and Treaty Verification Program); Trethewey, A.; Simak, R.S. Lawrence Livermore National

Lab., CA (United States). Oct 1994. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-950163–3: 3. international on-site analysis conference, Houston, TX (United States), 22-25 Jan 1995). Order Number DE95009878. Source: OSTI; NTIS; GPO Dep.

The Chemical Weapons Convention (CWC) expresses a preference for the analysis of samples at the site of the inspection during which they were collected. In order to accomplish this effectively a highly portable laboratory kit must be assembled in modular form to be transported to the inspection site. This kit must allow for the collection of samples, the preparation of samples for analysis and, finally, the analysis of the collected samples. The US Army Research, Development and Engineering Center (ERDEC) and the Lawrence Livermore National Laboratory (LLNL) under US Department of Energy funding have, largely through independent but coordinated programs, assembled such a laboratory kit. ERDEC and LLNL have joined with the UK Chemical and Biological Defence Establishment (CBDE) to evaluate and demonstrate the capability of the portable laboratory kit. The exercise, called the Cooperative, On-site Sampling and Analysis Experiment (COSAX) took place from 11 to 15 April, 1994, at the CBDE, Porton Down, UK. The paper describes the experimental plan, discusses, the results, and summarizes the findings.

379 (UCRL-LR–114070-3) **Director's Series on Proliferation.** Bailey, K.C. (ed.). Lawrence Livermore National Lab., CA (United States). 5 Jan 1994. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94005645. Source: OSTI; NTIS; GPO Dep.

This abstract series on Proliferation is an occasional publication of essays on the topics of nuclear, chemical, biological, and missile proliferation. Topics addressed in this issue are: Tactical nuclear weapons: Do they have a role in the US Military strategy?; Sanctions as a nonproliferation tool: Examining costs and benefits in the Iraqi case; Is the traditional regime enough? The US debate; the nuclear suppliers group: A major success story gone unnoticed; biological weapons: A priority concern; and problems with verifying a ban on biological weapons.

380 (UCRL-LR–114070-4) **Director's series on proliferation.** Bailey, K.C. (ed.). Lawrence Livermore National Lab., CA (United States). 23 May 1994. 112p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-931271–: Conference on nuclear, chemical, biological, and missile proliferation, Livermore, CA (United States), Dec 1993). Order Number DE94012773. Source: OSTI; NTIS; GPO Dep.

Biological weapons can be more horrific and devastating to mankind than nuclear weapons. Diseases perpetrated against an enemy can cause slow, agonizing death of civilians and soldiers alike; they cannot be limited in their effects only to the site of battlefield use, or to the day on which they are used. Indeed, long-lasting consequences may include mutations of the virus or bacteria into a more lethal form. It may also spread well beyond the intended victims to other populations. Biological agents are relatively easy and inexpensive to make. A biological agent can be produced in a laboratory costing only thousands of dollars. Time required, too, is less for biological weapons. Agent can be produced in days or weeks and weaponized with off-the-shelf technology. Making matters worse, biological weapons can be manufactured in small facilities that are impossible to detect with today's technology. Given that biological agents cannot be disinvented, the best hope is to convince countries to forego such weaponry. The Biological and Toxin Weapons Convention of 1972 outlaws the possession and use of such weapons. But this treaty, like all others, offers no guarantees, even if countries sign it. Developing the means to detect and defend against such weapons makes them less effective, and therefore less attractive to a user. This issue focuses on several aspects of the biological weapons problem: the history and current status of the biological weapons threat, and the US response to that threat; technologies for detecting and defending against biological agents; and obstacles to seeking additional arms or export control measures.

381 (UCRL-LR–114070-5) **Director's series on proliferation.** Bailey, K.C.; Price, M.E. (eds.). Lawrence Livermore National Lab., CA (United States). 12 Aug 1994. 89p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94018614. Source: OSTI; NTIS; GPO Dep.

This fifth edition contains some of the papers that were presented in July 1994 at the Lawrence Livermore National conference entitled "NPT: Review and Extension." Topics covered include: strategic warning and new nuclear states, the future for nuclear weapons, possibly stopping North Korean nukes without a war, Article VI of the nuclear nonproliferation treaty from the Chinese perspective, Article VI issues, Article VI and other NPT issues form the perspective of Russia, NPT review and extension, and finally problems facing total nuclear disarmament.

382 (UCRL-LR–114070-6) **Director's series on proliferation.** Bailey, K.C.; Price, M.E. (eds.). Lawrence Livermore National Lab., CA (United States). 17 Oct 1994. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE95001785. Source: OSTI; NTIS; GPO Dep.

This series is an occasional publication of essays on the topics of nuclear, chemical, biological, and missile proliferation. Essays contained in this document include: Key issues on NPT renewal and extension, Africa and nuclear nonproliferation, Kenya's views on the NPT, Prospects for establishing a zone free of weapons of mass destruction in the middle east, effects of a special nuclear weapon materials cut-off convention, and The UK view of NPT renewal.

383 (UCRL-LR–114070-7) **Director's series on proliferation.** Bailey, K.C.; Price, M.E. (eds.). Lawrence Livermore National Lab., CA (United States). 27 Dec 1994. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE95005655. Source: OSTI; NTIS; GPO Dep.

The Director's Series on Proliferation is an occasional publication of essays on the topics of nuclear, chemical, biological, and missile proliferation. The seven papers presented in this issue cover the following topics: Should the Treaty on the Nonproliferation of Nuclear Weapons (NPT) be amended?; NPT extension - Legal and procedural issues; An Indonesian view of NPT review conference issues; The treaty of Tlatelolco and the NPT - Tools for peace and

development; Perspectives on cut-off, weapons dismantlement, and security assurances; Belarus and NPT challenges; A perspective on the chemical weapons convention - Lessons learned from the preparatory commission.

384 (UCRL-TT-116961) **The deterrent strategy of nuclear weapons.** Barnard, L.D. Lawrence Livermore National Lab., CA (United States). 4 Apr 1994. 23p. Translation source information not available. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Source: OSTI.

Nuclear deterrence is examined. The balance of power since World War II is evaluated. Military strategy of nuclear warfare is discussed. The entire paper is seen from a viewpoint in which nuclear deterrence is beneficial, as is evidenced by the concluding quote, "if you want peace, prepare for war." (GH)

385 (UCRL-TT-117128) **White Book on Defense.** Lawrence Livermore National Lab., CA (United States). 12 Apr 1994. 164p. Translation source not available. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Source: OSTI.

1972–1994. Twenty-two years separate us from the first White Book on National Defense, published by Michel Debre during George Pompidou's presidency of the French Republic. This first volume summarized and clearly stated the principles of defensive policy defined by General de Gaulle. It marked for our national defense and for our armed forces the transition from the painful post-colonial period to a modern era. A number of those pages remain as powerful and as valid nowadays. The events that have taken place since the fall of the Berlin Wall, the disappearance of the Warsaw Pact, with the European and international environment changing at increasing speed, advances in technology or economic life, have led me, with the consent of the French president, to make the publication of a new White Book a government priority. To take into account hypothetical international developments, to state the goals of our defense policy and the strategy chosen by France, to present the larger framework the activities of the armed forces exist in, as well as to describe the nation's resource policy: this shall be the purpose of this book.

386 (WSRC-MS-94-0486) **Vitrification of excess plutonium.** Wicks, G.G.; Mckibben, J.M.; Plodinec, M.J. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-950216-63: Waste management '95, Tucson, AZ (United States), 26 Feb - 2 mar 1995). Order Number DE95006452. Source: OSTI; NTIS; INIS; GPO Dep.

As a result of nuclear disarmament activities, many thousands of nuclear weapons are being retired in the US and Russia, producing a surplus of about 50 MT of weapons grade plutonium (Pu) in each country. In addition, the Department of Energy (DOE) has more than 20 MT of Pu scrap, residue, etc., and Russia is also believed to have at least as much of this type of material. The entire surplus Pu inventories in the US and Russia present a clear and immediate danger to national and international security. It is important that a solution be found to secure and manage this material effectively and that such an effort be implemented as quickly as possible. One option under consideration is vitrification of Pu into a relatively safe, durable, accountable, proliferation-resistant form. As a result of decades of experience within the DOE community involving vitrification of a variety of hazardous and radioactive wastes, this existing technology can now be expanded to include immobilization of large amounts of Pu. This technology can then be implemented rapidly using the many existing resources currently available. A strategy to vitrify many different types of Pu will be discussed. In this strategy, the arsenal of vitrification tools, procedures and techniques already developed throughout the waste management community can be used in a staged Pu vitrification effort. This approach uses the flexible vitrification technology already available and can even be made portable so that it may be brought to the source and ultimately, used to produce a common, borosilicate glass form for the vitrified Pu. The final composition of this product can be made similar to nationally and internationally accepted HLW glasses.

387 **Extending the non-proliferation regime - more scope for the IAEA?.** Texte und Materialien der Forschungsstaette der Evangelischen Studiengemeinschaft. Reihe B, v. 21. Fischer, D.; Chauvistre, E.; Mueller, H.; Eisenbart, C. (ed.). Evangelische Studiengemeinschaft e.V., Heidelberg (Germany). Forschungsstaette. Mar 1994. 95p. Source: Available from FIZ Karlsruhe.

The 6 papers and positions presented at the meeting discuss the future of the IAEA after the cold war, the limits of IAEA safeguards reform, the new role for NATO and the Iraq Case. The authors hope in this way to contribute to the national as well as the international discussion of questions that now as ever concern the survival of human kind. (HP)

388 **A Japanese strategic uranium reserve: A safe and economic alternative to plutonium.** Leventhal, P. (Nuclear Control Institute, Washington, DC (United States)); Dolley, S. *Science and Global Security (United States);* 5(1): 1-31 (Dec 1994).

Japan could acquire a 50-year reserve of low-enriched uranium fuel for its nuclear power plants at about half the cost of its plutonium program, providing energy security and major economic and political benefits. Fuel for light-water reactors made with plutonium costs four to eight times as much as conventional uranium fuel. Japan can develop a Strategic Uranium Reserve to address its energy security concerns and eliminate any need to proceed now with plutonium recycling with its many attendant costs and nuclear proliferation risks. Such a reserve could provide as much as a 50-year, energy-secure timeframe within which Japan could develop the commercial breeder reactor later on, if necessary. A discounted cash flow analysis demonstrates that, by developing a 50-year uranium reserve instead of a commercial plutonium and breeder program, Japan could save up to $22.7 billion. Savings would be greater (up to $38.4 billion) if an enriched-uranium reserve smaller than the extreme 50-year example or a reserve of natural uranium were acquired. The reserve would also make a major contribution to keeping the Asia-Pacific region free of weapons-usable nuclear materials.

389 **The cessation of production of weapons-grade plutonium in Russia.** Diakov, A.S. (Moscow Institute of Physics and Technology (Russian Federation)). *Science and Global Security (United States);* 5(1): 33-35 (Dec 1994).

As a result of nuclear arms reductions, 10 of the 13 Russian plutonium-production reactors have been shut down,

and Russian President Yeltsin has pledged that the three remaining reactors will be shut down by the year 2000. However, the closure of these reactors will not be a simple matter. The three production reactors have been operating since the mid-1960s as dual-purpose reactors producing plutonium for weapons as well as heat and electricity for local residents.

390 **Converting Russian plutonium-production reactors to civilian use.** Dmitriev, A.M. (Russian State Committee for Radiation Safety, Moscow (Russian Federation)). *Science and Global Security (United States);* 5(1): 37-46 (Dec 1994).

The first Soviet reactor designed to produce weapon-grade plutonium began operation in Chelyabinsk in June of 1948. In 1958, a graphite-moderated production reactor was built to operate in dual-purpose mode, producing both weapons-grade plutonium and heat and electricity for local residents. In 1963, the first and only US dual-purpose reactor was built in Hanford, Washington. The reactor was shut down for upgrade in January 1987 following the Chernobyl accident and its operation has never been resumed. There are major differences between US and Russian dual-purpose reactors. This article outlines those differences and the problems involved in the conversion of the Russian reactors to civilian use.

391 **Excerpt from "Summary of Near-Term Options for Russian Plutonium-Production Reactors".** *Science and Global Security (United States);* 5(1): 47-62 (Dec 1994).

The Russian Federation desires to stop producing weapons-grade plutonium. During the last several years, ten graphite-moderated, water-cooled, production reactors have been shut down. However, complete cessation of weapons-grade plutonium production is impeded by the fact that the last three operating Russian plutonium-production reactors supply electrical energy and district heat as well as produce plutonium. These reactors are major suppliers of heat in the Tomsk and Krasnoyarsk regions of Siberia.

392 **North Korean plutonium production.** Albright, D. (Institute for Science and International Security, Washington, DC (United States)). *Science and Global Security (United States);* 5(1): 63-87 (Dec 1994).

In 1992, as part of its obligations under the Nuclear Non-Proliferation Treaty, North Korea declared that it had earlier separated about 100 grams of plutonium from damaged fuel rods removed from a 25 megawatt-thermal (MW_t) gas-graphite reactor at Yongbyon. The plutonium was separated at the nearby "Radiochemical Laboratory." Separated plutonium is the raw ingredient for making nuclear weapons, but 100 grams is too little to make a crude bomb. Based on intelligence reports and IAEA inspections, North Korea may have separated enough plutonium for a nuclear weapon. Regardless of whether this is true, there is no doubt that North Korea has enough weapons-grade plutonium in spent fuel to make four or five nuclear weapons. But it cannot turn this plutonium into nuclear weapons unless it separates the plutonium from the spent fuel. Preventing the North from separating any more plutonium must remain a global priority. The IAEA must also be able to verify North Korea's past nuclear activities and determine the amount of plutonium North Korea may have diverted in the past.

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